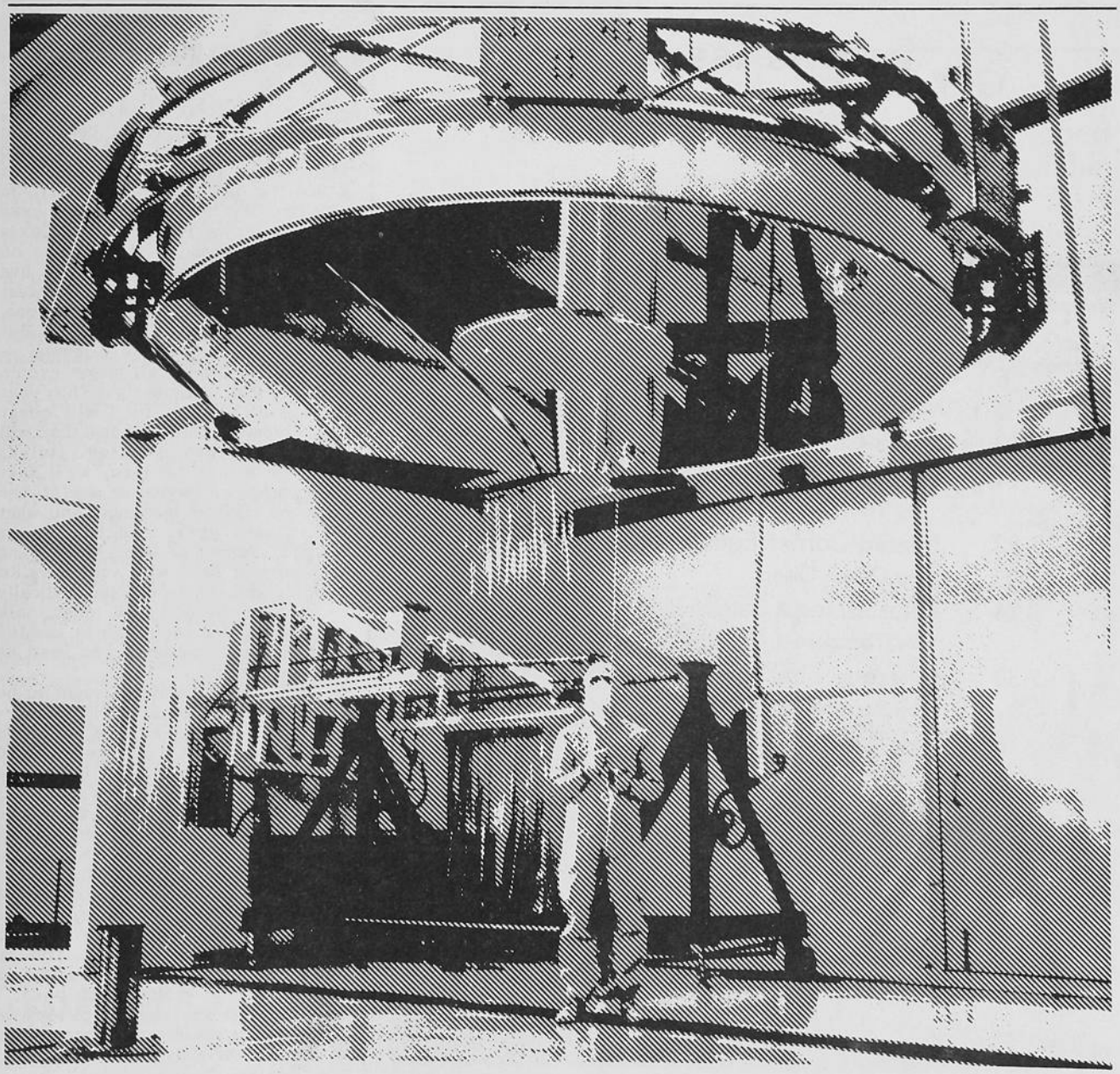
TELESCOPE MAKING 15

ISSN 0190-5570

The magazine *for*, *by*, and *about* telescope makers!



TELESCOPE MAKING

The magazine *for*, *by* and *about* telescope makers!

Editor: Richard Berry

Associate Editor: Robert E. Cox

Managing Editor: Katherine M. King

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COVER: The Space Telescope primary mirror had just come out of the coating chamber when this picture was taken. Photo courtesy Perkin-Elmer OTD Division.

Editorial

For the first time in history, there may be too many telescope conferences -- and that is a good thing, a sign that telescope making is a healthy and growing activity. So why do I say "too many"? This year the Riverside TMC and the Texas Star Party overlap — they happen on the same weekend. Now if you live on the East Coast or in the Midwest and aren't going to get to either one, you're going to say "big deal." But for TM it's a bit of a dilemma -- how can we "cover" all major events for the TM community? This year there is no problem, for I will cover the Riverside TMC and Bob Cox will cover the Texas meeting. Unless someone comes forward, we'll have no coverage of Dayton or any of the League's regional meetings. And what about next year, and the years beyond? Sooner or later, we're going to need your help, with volunteers to attend, look at telescopes critically — and spot the best new ideas, talk to people, get their names spelled correctly, take pictures, and send us their reports.

This year's meetings ought to be really fun — I'll be at IAPPP, too -- so I'll get my high-altitude sunburn a bit in advance this year. And although my main interest lies in the creative efforts of the amateur builders, in the last year the commercial outfits have been making such a big fuss in their ads that I'm hoping to do some comparing. Since nobody in Milwaukee stocks one of the brands, I haven't even been able to satisfy my own curiosity with simple side-by-side star test. Out on their home turf, and presumably not on the parade ground this year, I expect we'll see sample telescopes available for an informal competition. If not, I'll certainly wonder why not.

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RICHARD L BERRY
BOX 92788
MILWAUKEE WI
53202

Telescope Making/Circulation Dept./P.O. Box 92788/Milwaukee, WI 53202

You've probably already noticed that this issue of TM has a few more letters than usual. Actually, what's happened is that the last several issues haven't had enough, so I'm catching up on the backlog. At present, TM has a backlog of articles on hand also, probably enough to fill TM#16 without any further submissions. If you've submitted something and haven't yet heard from us, please don't worry about it, it's in the pipeline and will eventually emerge in print. TM publishes "perishable" articles first, so the less time-dependent your article, the longer the wait. Unfortunately, we tend to get behind on the "letter back to the author" kind of paperwork sometimes, but can assure you that we've only lost one article so far.

Actually, it's a rather ordinary case of misfiling, we think. The lost article arrived as a box of slides and a letter. Slides are difficult for us -- I take them home, copy them on b/w film in my trusty Spiratone DupliVar, and make black and white prints. (You can now see why we prefer black and white prints with articles.) When I brought the prints in to work, I couldn't find the letter. So, on page 4, you can see the pictures but no letter. Actually the basic story is self-explanatory, it's a 17.5" Dobsonian, uses a permanent rocker box out in the backyard, and he has a clever way of handling the side bearings. Where did the letter go? Probably it got into another file, though we've searched and haven't found it. If you're the author, please drop us a note and claim credit. Thanks.

Sincerely,
Richard Berry
Editor

Letters

"Figuring Thin Mirrors" Delayed

Dear Richard / This photo is of the Fiddletown Observatory that over the last 6 months has occupied a majority of my spare time which I might have spent writing Part 3 of the Thin Telescope Mirror article. In itself, it did not prevent the making of the deadline, but it did provide enough distraction for someone like myself who is devoted to procrastinating such things as writing.

The observatory was completed in October. It is now home for my 18" f/5 reflector; a 25" telescope is under construction. The observatory is located about 45 miles east of Sacramento at an altitude of 2650' in the foothills of the Sierra Nevada Mountains. It provides excellent seeing conditions and is accessible year 'round.

The 15' x 20' observatory building is surrounded by a large packed-gravel observing area for use by amateurs with portable telescopes.

Bob Kestner
Concord, CA

R.E.C./C.O.A.

Effective June 5, Robert Cox's new address will be:
305 Linda La.
O'Fallon, MO 63366

A Bit of Grousing

Richard / I am probably the last in a long line of complainers; however, I would like to ask for some additional information.

(1) Could you provide an example for Steve Kysor's article in TM#13? I am preparing a

Letters

similar program for a TI-58.

(2) Line 20 in his program is an obvious misprint. I think it should read

20: H = (T-R)*15.

This is the only time I have had any complaint concerning TM as long as I have been a subscriber/distributer. Please keep it up.

My only other complaint does not concern TM but ASTRONOMY. I finally got up enough nerve to start my own business and sell astronomical items as well as magazines under the company name of Opticks. Of course ASTRONOMY and TM were on the top of the list. And then ASTRONOMY made the wise decision to have them distributed via the general newsstands. Do you realize that it costs me more than the face value to carry ASTRONOMY without the option that the newsstands have to return unsold copies? Oh well, enough complaints and a happy note to end on. Please keep up the good work with TM. See you at Stellafane next year — it's been 14 years in a row for yours truly.

Barry L. Matthews
P.O. Box 6245, Sta. J
Ottawa K2A 1T3
Ontario, Canada

P.S. What is "Gatorfoam" for us Canadians who have nothing but snow.

— Tom Dey's article in this issue provides you a better and more sophisticated program for the TI-58, and Paul Burke's article in the April ASTRONOMY provides a worked example. Sorry about the error in the program — it was a typo. By the way, for "How to Build a Dobsonian Telescope," second edition, we have eliminated this error.

Gatorfoam is made by the International Paper Company, Uniwood Division, P.O. Box 5380, Statesville, NC 28677, phone 704-872-8974. It is a laminated foam panel, waterproof, light, and rather rigid. It costs about $35 per 4' x 8' sheet. They list a E.M. Plastic and Electric Products, 34 Millwick Ave., Weston, Ont, M9L 1Y3, phone 416-749-2313 in their 1980 distributor booklet.

Gatorfoam Blues

Dear Richard / I have long enjoyed TELESCOPE MAKING magazine and find it helpful in thinking out my next telescope project. But now I am compelled to write and say that Robert Kelly's article in TM #13 on using Gatorfoam laminated foam panels was truly inspiring!

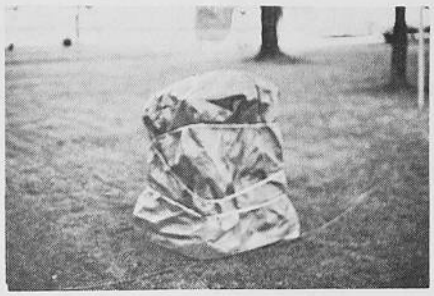
He has opened the door to really lightweight, large-aperture telescopes. For over a year I have been puzzling over how to build a 17.5" Dobsonian in a lighter design, easy enough for one man to handle and transport. I intend to pursue the practical problem of actually building it later this year.

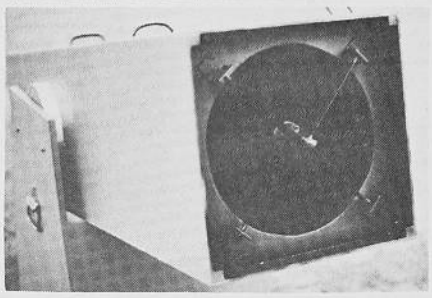
One difficulty I have already encountered is that apparently Gatorfoam does not exist in Los Angeles. Laminating 1/16" high impact styrene sheets to rigid foam insulation panels seems to be a workable, but expensive alternative — about $50 for a complete 4 x 8 panel.

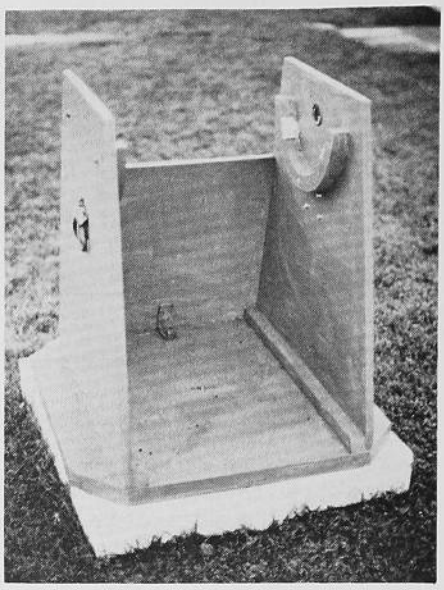
I would be interested in hearing even further from Robert Kelly about Gatorfoam and hope he has explored further than that wonderful telescope he built for his son. Any information leading to my acquiring 2 panels of ¾" Gatorfoam will be greatly appreciated.

Allan S. Abrams, M.D.
4726 Winnetka Ave.
Woodland Hills, CA 91364

— Try Fome-Boards of California, 5014 Hampton Street, Vernon, CA 90058, phone: 213-588-9211. Gatorfoam isn't cheap, but neither is any other kind of tubing, with the possible exception of Sonotube in all its varieties.



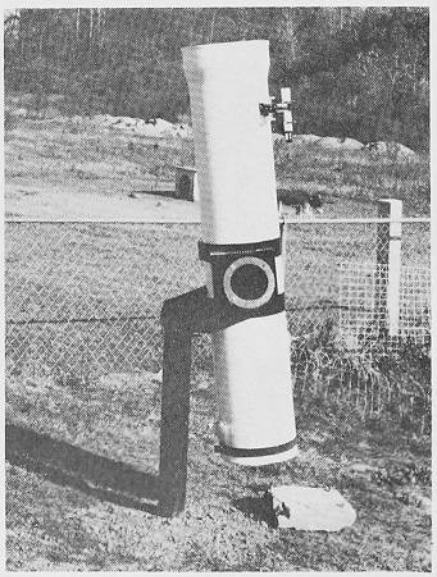




Would the TM who sent us these photos please identify himself.

A Pier-Mounted 10" Scope

Dear Mr. Berry / I have enclosed two photos of my 10" f/5.3 Newtonian reflector. Although I built the telescope from "How to Make a Dobsonian Telescope," I've made a few changes in the mount. It's made entirely of steel, and the bearings for the vertical plane are made of brass 1" thick x 8.25" O.D., and the 4" pipe used for the pedestal has been turned down so it fits snugly inside the pier. The horizontal plane uses no bearing, only grease, and, surprisingly, turns fairly smoothly.



The telescope tube is PVC 12.5" O.D. hard plastic tubing used for water pipe nowadays.

The scope works and performs great, and should last forever. It took me 6 months to get my mirrors from Coulter Optical Co., but was well worth the wait. At first I built the plywood mount but the weather destroyed it, so Steve Boyd, a friend and co-worker of mine, helped me build the all-steel one.

Leon Turner
50 Patti Court
Franklin, OH 45005

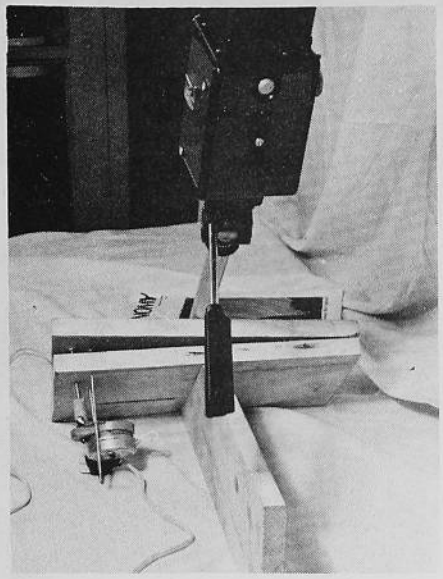
Haig Mount Revisited

Dear Sir / I built and used the simple astro mount as described in TM#7, but found that it is tedious turning the bolt and it is difficult to coordinate the time and movement in the dark. I thought there must be a better way. That is what this letter and photographs are about.

For an investment of $1.50, I found a better way. While browsing through the shelves at American Scientific, I came across a 2.5-watt timing motor, 110 volt, 60 cycle, 1 RPM, counterclockwise shaft rotation. The problem now was to find a way to couple it to the astro mount.

I coupled the motor to the bolt with a 1" length of ½" diameter dowel rod. Half the length of the rod is drilled and tapped and screws onto the end of the bolt, and the other half is drilled to the same diameter as the motor shaft.

To keep the motor from pulling out of the coupler, I placed a ⅛" tapped hole at right angles to the motor shaft hole. My junk box yielded a ⅛" machine screw with matching threads. The screw was cut down to 7/16". The motor shaft along one side of its length is flat. The set screw holds the motor to the coupler by holding the shaft on this flat side. Care



must be taken not to make the set screw too tight as the threads in the coupler are only wood. Ideally, the coupler should be made of metal.

To keep the motor from turning with the shaft, make use of the two holes on the mounting flange. I salvaged two metal rods of slightly smaller diameter than the holes from an old paint roller.

As the motor turns, it is also pulled up toward the board. When the motor is all the way up, release the set screw and slide the motor down the rods. Turn down the bolt by hand, replace the motor shaft, tighten the set screw and you are ready for more astrophotography.

Any timing motor can be used, but it must turn counterclockwise. For $2.00 I purchased a beautiful 6 watt, CCW, 1.2 RPM motor. Any combination of time and threads can be calculated by simple arithmetic, so long as the two boards open 5° in 20 minutes.

The 2.5-watt motor provides enough torque to move the mount carrying a heavy Graphic 22 TLR. TLR cameras are ideal — the 2¼" negative enlarges nicely, and the cross hairs on the viewer act as a crude guidescope to see if the tracking has gone correctly.

Donald Wahle
4141 West Barry Avenue
Chicago, IL 60641

Bardou Refractor

Gentlemen / Could you please send me any information you can about the telescope described below. I have enclosed a photograph.

Name on telescope: BARDOU & SONS, PARIS

Length: 47"
Height: 57"
Lens diam.: 3.5"
Small scope: 8.5" long

I'd be interested in any date you could give me for it, and the value, or what it's worth today.

Rev. George Wiltz, S.J.
President
Jesuit High School of Tampa, Florida
4701 North Himes Avenue
Tampa, FL 33614

Casting a Mirror

Dear Mr. Berry / Thank you very much for TM, and the contact it provides with other TMs. The article in TM#14 on "Honeycomb Mirrors" really blew me over. As long as I've been an amateur astronomer, I've also desired a large mirror, but the high prices of blanks imported into Canada led me to also build a casting kiln very, very similar to the one described by Hill and Angel.

My own project started about a year ago, based on the idea that glass would be cast as metals are. I, too, found the reference books listed by Hill — *Electric Kiln Construction for Potters* and *Kiln Building with Space Age Materials* — in the local library, and found sources for the various firebricks, wire, etc. at outlets that cater to the ceramic trade.

An additional book that helps others is *Glassforming* by F. Schuler, outlining techniques of glass casting and the materials used in the critical aspect of mold building. One very important area omitted, or passed over too quickly by Hill and Angel, is glass annealing.

I can't overstress the importance of proper annealing schedules to prevent glass fracture. The best source that I've come across is *Flameworking*, also by Schuler, which gives a very detailed formula (with examples) for initial rates of heating, soaking, and final annealing for both plate glass and pyrex type glass from ½ inch to 4 inches thick. These values for cooling are constant ratios and can be extended to any thickness in glass coating from ½ to 7 inches. Both the above books are published by the Chilton Book Co., New York.

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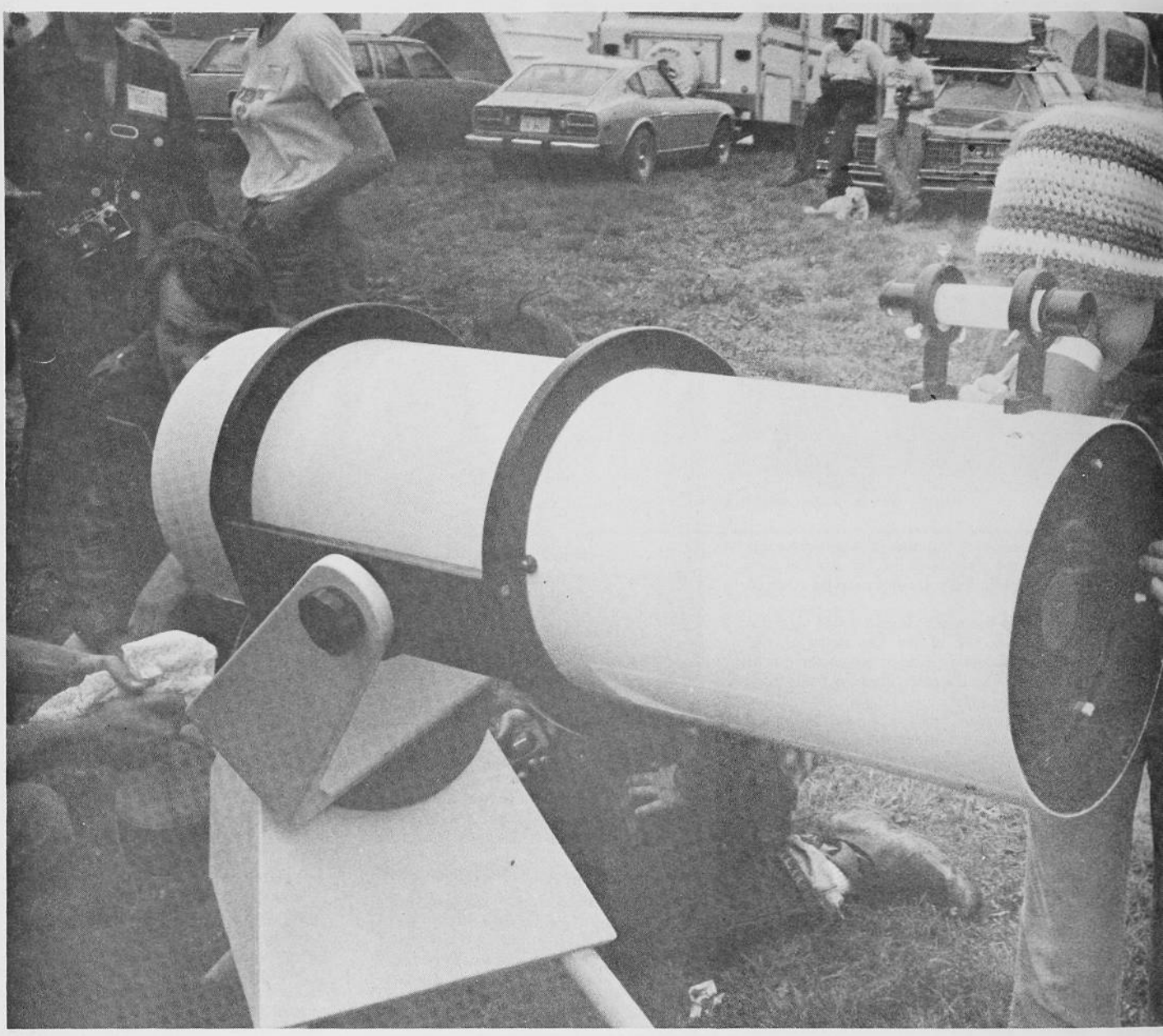
АКАДЕМИЯ НАУК СССР

ИНСТИТУТ НАУЧНОЙ ИНФОРМАЦИИ

2.51.61. «Конструирование телескопов», 1980, № 8. «Telescope Mak.», 1980, № 8 (англ.)

Содержатся статьи: Buchroeder R. A. «Камера Houghton»; Berry R. «Добро пожаловать на Риверсайд 80 о встрече в Риверсайде любителей телескопостроения)»; Cox R. E. «Монтировка Poncet»; Berry R. «Как контролировать сцепление в телескопе Dobsonian»; Spry R. «Вращающаяся обсерватория»; Bailey J. «Тренога для C-8 Dynamax»; Reisenweber R. C. «Вилочная монтировка 8" Кассегрена».



ASTROFEST

The second annual northern-midwest gathering of telescope makers convened over the weekend of September 25-26 at the Modine-Benstead Observatory in Racine, Wisconsin. The weather conspired, however, to make things less convenient than they had been for the 1980 meeting. By the time I arrived Friday evening, the meeting name had been provisionally changed to "Aquafest" and the suggested observing apparel of the meeting was scuba gear!

By Saturday night, the meeting had acquired another endearing term — "Mudfest" — as the Wisconsin soil worked its way through the soaking grass to make a sea of mud. This was the only meeting I have ever attended in which I went home with more beautiful feet than I arrived with, since they were in a mud-pack for more than 24 hours!

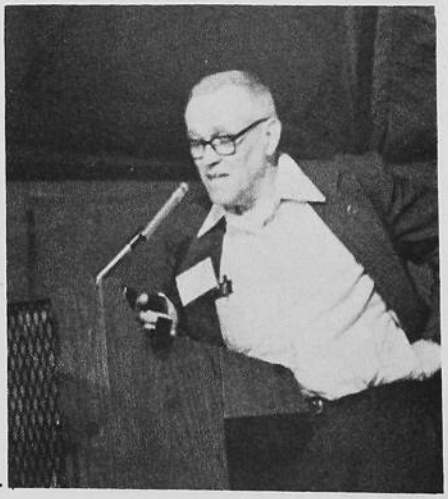
In spite of the weather, the meetings weren't really a washout, since the official registration reached 173 and the inclement weather, rather than discourage those present, brought us closer together. After all, we were trying to share umbrella coverage.

Delegate Berton helped make life enjoyable especially for the families and the less dedicated telescope makers by a large library of science fiction films on video tape which played almost continuously during the sessions. To pass the rainy Friday evening all of us found the classic *The Day the Earth*

Burton and Alseits open Astrofest 1981

Papers were presented in Bld. #3

Afterbuffet speaker Robert E. Cox



"good in spite of the mud"

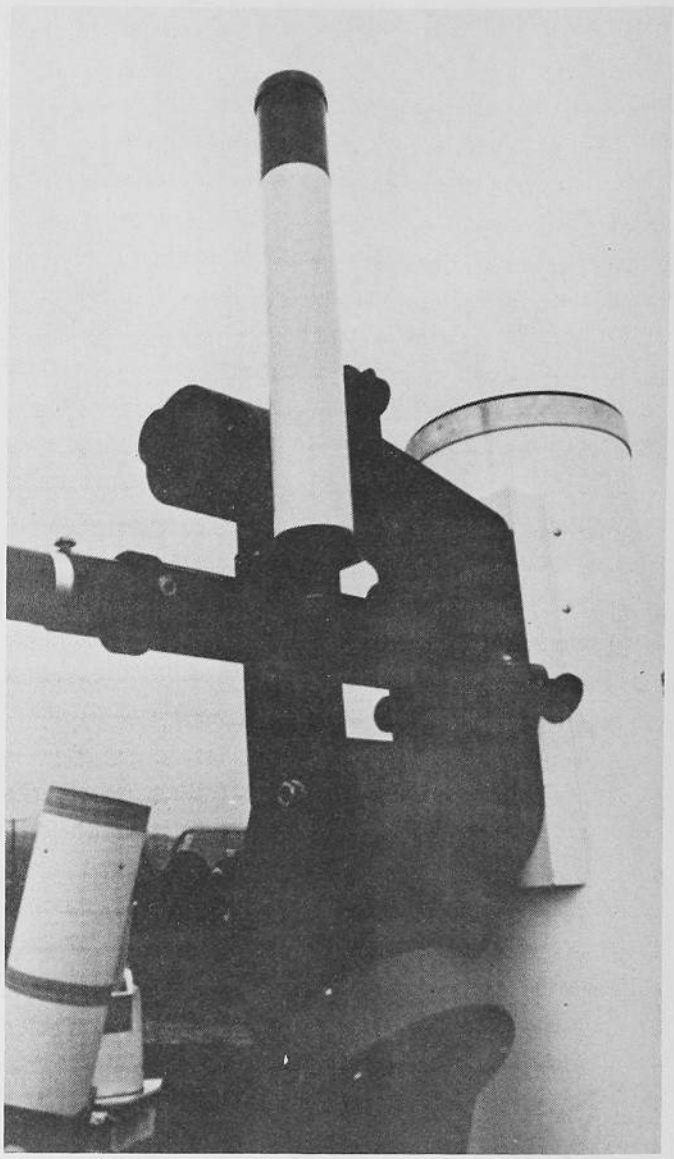
photos by Bob Cox, Mark Jones, James Bailey, and R. Berry

Stood Still both interesting and nostalgic.

The talks were informal, except for the two key-note speakers, with those interested attending or examining the various items for swap or sale at the flea market under some tents. Since the weather gave us time on our hands, the presentation by William Andrewes of the Time Museum in Rockford, Illinois was most appropriate, "The History of Astronomical Clocks." Ralph Winrich of NASA Lewis Research Center spoke on "The Voyager Missions" in the afternoon with many attending crowding into the building to hear him.

Other topics covered were: "Observing the Moon, It's Not Just for Lunatics" by Larry Jahn, Naperville A.S.; "Design and Construction of a 10-inch Newtonian-Cassegrain" by Robert E. Karak, N.W. Suburban A.S.; "Constructing a Hydrogen-Alpha Prominence Telescope" by John D. Phelps, Jr., Chicago, A.A.; "The

Lauren Nelson and his Springfield.

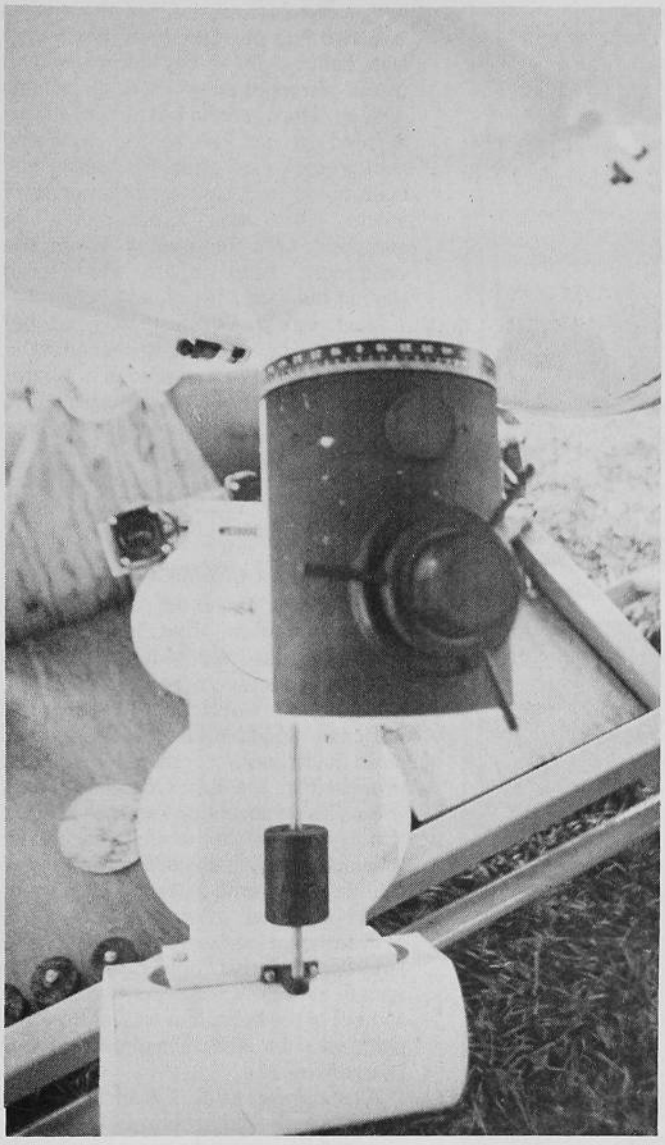


The 3-axis mount built by Richard Ames.

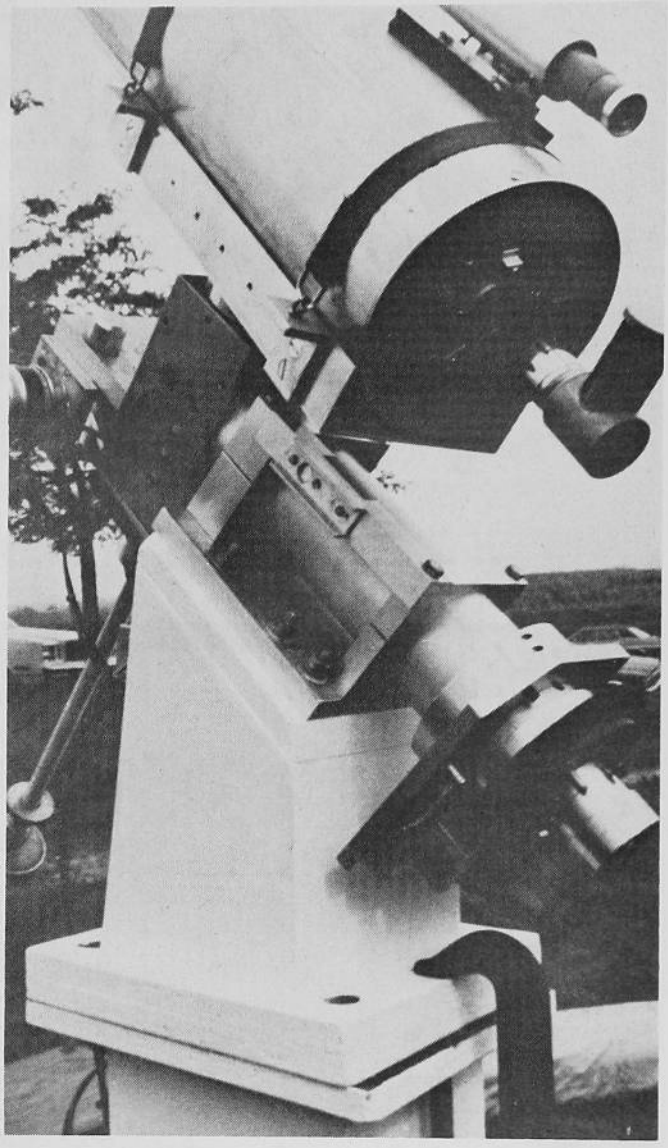
Under canvas in the rain . . .

Voyager II Pictures" by Richard Berry of ASTRONOMY and TELESCOPE MAKING magazines, Milwaukee, Wis.; "An 8-inch What?" by James H. Fox, Afton, Minn.

After the banquet, an excellent buffet — and what is second in importance to the astronomic but the gastronomic? — I had the privilege of showing slides of the famous TMs of the past from a collection of pictures dating back through some 48 years of telescope making. Included were Russell W. Porter, Albert G. Ingalls, Wally Everest, Dr. Henry Paul, Allan Mackintosh and many others. Some of the ingenious telescopes and mountings from years ago show that today's amateurs are still coming up with telescopes with the same basic design features. Little has changed, but the biggest modern advances are the application of electronics to mountings



Marion Warling's 14" f/20 torque-tube Springfield.



Gerry Frey's sturdy German equatorial.

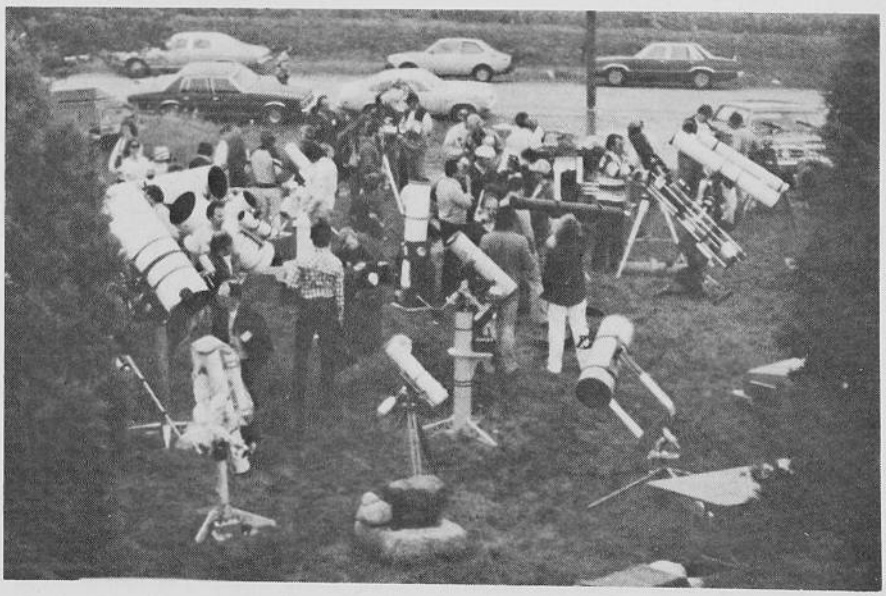
and at focal planes for photometry.

Fortunately not all the weather was bad. After lunch Saturday the rain held off and the delegates hurriedly assembled their instruments on a dry mound in front of the observatory. The judges had to work quickly to appraise the telescopes. For their convenience and ease of operation, there were a number of Dobsonian mountings. Some were well designed, while others were somewhat too free in their movement, especially on the altitude axis.

Equipment varied from the simplest to some very sophisticated assemblies. Lauren Nelson of St. Paul showed a 6-inch f/3.5 to f/11 Springfield telescope he uses for solar work. It was one of the most outstanding telescopes presented. His pictures of solar surface and prominences are of professional quality.

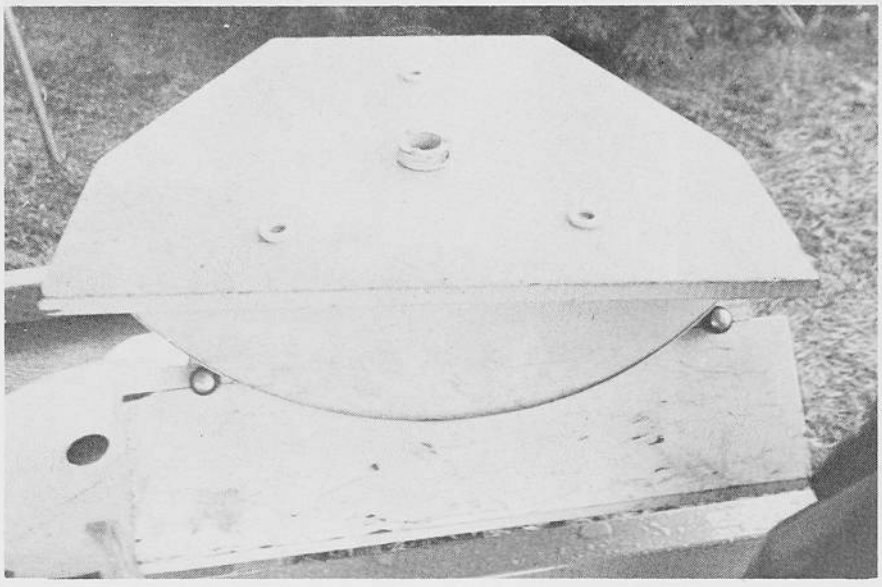
I have never in my life seen such a

. . . out on the lawn when it cleared off. Photo: Bailey



Poncet mount — north end.

John Spindler's Cassegrainian



Three "sitting dogs" — inverted forks.

jungle of telescopes! All of them were crowded into one little area that was at least halfway dry — but unfortunately it made photographing them extremely difficult. The intended instrument always seemed to get lost in the confusing background. Just after the judging had been completed, we heard that another storm front was approaching, so everyone went scrambling to get the equipment taken apart and stored against the weather.

Next year's Astrofest — what pet name it will have will be determined at the meeting — will be announced at a later date, but in spite of the weather, all of us who attended will be anxiously looking forward to coming back.

Robert E. Cox
TELESCOPE MAKING

Aquafest or Astroswamp?

Those of you who did not attend this year's AstroFest, that is, you who chickened out only because of heavy thunderstorms, torrential deluges, mudslides, hurricane-force wind velocities and the threat of beach-ball sized hailstones. . . shame on you! I promised in the last *Observer* that if there was an absence of seismic activity, this year's event would indeed be memorable. Well, it is difficult to believe that any of us who attended could ever forget it. What a fabulous display of hydro-meteor showers we witnessed! And do not forget those of the igneous variety as well. Knee-deep mud and the symbol of the flying tent canvas now join nylon screws and AstroPests in our beloved folklore.

All anopheles aside, it is amazing what was accomplished at AstroFest '81. The camaraderie, the light-hearted sense of resignation to our plight, and the wonderful sights and sounds experienced there may make the drudgery of the mud seem to evaporate from memory. We enjoyed masterful presentations by Mr. William Andrewes of the Rockford Time Museum; Mr. Ralph Winrich of the NASA Lewis Research Center and Mr. Richard Berry of TELESCOPE MAKING, in addition to the talks by those in attendance. Voyager vistas from NASA, the clocks and chronometers of Mr. Andrewes and the continuous wit and lore of Bob Cox were awe-inspiring. Despite the inclemency, there was a display of some mighty well-crafted instruments from all over the midwest.

And, for all the inconveniences put upon us by Meteora (the weather goddess), there was observing. Those of us who stuck it out late on the evening of the 26th were rewarded with clearing skies! It was a near total surprise coming as it did after what we had endured, but

'Fest Winners

Name	City/State	Telescope Type	Award
Richard Ames	Oshkosh, WI	8" f/5 erect-image Newtonian 3-axis equatorial mount	Excellent Design
Alan Beaman	Rockford, IL	4" f/7 Newtonian, on Zeiss-type "Sitting Dog" mount	Good Workmanship for young novice ATM
Barry & Carol Beaman	Rockford, IL	6" f/8 Newtonian, on Zeiss-type "Sitting Dog" mount	Good Inexpensive Design
Lauren Nelson	St. Paul, MN	6" f/3.5-f/11 Springfield	Excellent Workmanship Design
John D. Phelps, Jr.	Orland Park, IL	2" H-alpha prominence telescope	Innovative Solar-Powered Drive
Walter Piorkowski	Chicago, IL	9' Hale-type spectroheliograph	Excellent Workmanship and Design
Carl Rezek	Villa Park, IL	6" f/15 refractor on German equatorial	Good Use of Pillow Blocks on Large Portable Refractor
John D. Spindler	Wildwood, IL	6" f/18 Dall-Kirkham on German equatorial	Very Clean Design and Workmanship w/variable-frequency drive
Marion Warling	Minneapolis, MN	14" f/20 Springfield torque tube mount on trailer	Excellent Design for Portable Springfield
Cary M. White	Sterling Hts, MI	6" f/4 RFT Newtonian	Good Photo/Visual Eyepiece Mount Design

Note: Our apologies if we've labelled any photos wrong — our notes were nearly too soggy to read!

shortly after 10:30 p.m. the 16-inch dome slit was opened and the Fox Valley Astronomical Society set up their 10-inch f/4.75 on the concrete pad just south of the main building. I saw the Ring Nebula in the 16-inch and then dropped down to catch some sights in the 10-inch. I ought to have, it was using a primary mirror I made back in early 1978 and was designed for raffling off at the national Astronomical League Convention held in Madison in June of that year. Fox Valley won the raffle and got the entire instrument operational a few months ago; this was my first opportunity to look through it. I tracked down M-92, M-71, M-45, NGC-6960/6995, NGC-7331, and NGC-891 before finishing off on the Andromeda Galaxy and companions.

I can hardly wait till next year!

Daniel P. Joyce
from the *CAS Observer*

Then the tent blew down . . .

CCCC

Cox's Calculator and Computer Corner

CCCC is a service to our readers to help you know what programs, calculators, and computers are available and how to obtain them. This column will appear in TM whenever there's enough material in the hopper to be worth printing. To help us help you from the frustration of unworking or unworkable programs, however, we're going to ask you to abide by the following policies:

1) TM will not publish programs. Programs are too long, take too much space, and there's too much chance for error. Beside, we don't want to crowd the telescope out of TM. But we will tell you where you can get programs, what their important characteristics are, and what makes them of interest to you.

2) We will not run notices for similar programs. Check carefully what we have already published before submitting a program. We welcome unusual approaches, short cuts, and new ideas, but those which are not significantly different from already published material will be returned.

3) Wherever possible, TM will have checked programs for accuracy and correct operation. However, we cannot guarantee any program. We will indicate whether we have checked it when we publish the source.

4) Programs must include the mathematical formulae used to develop them and the sources of the formulae. If such information is proprietary, we will not publish it, but we feel we should not publicize the availability of a program unless we understand the basis of the program's operation.

5) Telescope design parameters will not be published unless a prototype has been fabricated and field tested. It's much easier to make numbers than it is to grind glass — we don't want to waste any reader's time and effort in fabricating a faulty design.

6) When submitting a program, please let us know what it will cost you to send out photocopies and magnetic cards to those requesting them from you. Make up a sample reply envelope and weigh it to determine the postage.

7) Send all programs and inquiries to:

Robert E. Cox
305 Linda Lane
O'Fallon, MO 63366
Phone: 314-272-3592

P.S. Please note that this is a new address and phone number.

Robert E. Cox

Maksutov Ray Trace

The first listing of a program availability is that of W. Sutherland of the United Kingdom whose article on the design of a Gregory Maksutov telescope with a pocket calculator appears in TM 14. Two versions of this program are available and both have been checked by the writer on their respective machines and operated correctly.

The first program is for the Casio FX502P and FX602P pocket calculator. Results on these machines are read and recorded from the display as it doesn't have a print capability; however, programs can be recorded on a tape machine and played back into the calculator with a special adapter. The Casio also has continuous memory and when turned off, the program and related memories stay in the machine and are ready for use immediately when it is turned on again.

The program takes five selected parameters of a Gregory-Maksutov design and calculates the others for the optimum situation set by the first listing. If these are satisfactory, then the design program is run and a total running time of 24 seconds calculates the BFL, spherical aberration, its tolerance, the focal length of the system, and the coma one can expect for an axial ray. By substituting one or more parameters, the operator can vary the results to obtain a design within the tolerances for such a design. By changing the index of light the program will do the calculations for varying wavelengths, of light so its error and tolerance can be determined.

There are two versions of the program for the TI-59 machine: one does the same calculations as the Casio, but the other -- which would be used by most workers with a printer — is the more practical program. Entering the program with magnetic cards, the display shows the five selected parameters to be entered. After the thin lens design is completed, the results are printed out with the location of each in its memory so if one wishes to change the parameters without going further, it is easy to do so. If satisfied and the design program run, the final print-out lists the same aberrations as the Casio but with identification of each in the right hand margin.

Entering the desired percentage value of a zone (usually 10%), the program calculates the spherical aberration of all the zones from 90 to 10 percent. If the two principal colors used in ray tracing are entered first, the program automatically calculates the zonal spherical for all three colors without stopping (this will take more than 10 minutes so relax and don't get nervous when the calculator continues to run after the first few minutes).

These programs can be obtained from:

W.H. Sutherland
13 St. John's Crescent
Whitchurch
Cardiff CF4 7AF
Wales, U.K.

However, due to the cost of overseas

mail —in May 1981 it was 40 cents per half-ounce and it is impossible to say what it will be by the time this is read — those just wishing to receive a program listing and explanation can contact Bob Cox. If one wishes more information or technical advice, then Mr. Sutherland should be contacted in Wales. In receiving programs from me, send a legal SASE to my home with one stamp at current rates. Incidentally, those with a TI-59 and printer can receive magnetic cards of the programs, besides the listings, if they will send three cards with their request (also put two stamps on the SASE envelope!).

The Casio FX602 Calculator

One of the most exciting electronic developments of the past decade is the pocket programmable calculator. For the amateur astronomer and telescope maker these devices are an invaluable tool for application in the hobby of astronomy.

Through my work at the McDonnell Douglas Company in St. Louis, I have had constant contact with the pocket calculator field since its inception. The engineers used these to aid their design work and have thus enabled me to see and work with most scientific machines. I have tried the Hewlett-Packard, Texas Instrument, Commodore, and Casio calculators — just to mention a few — and have been able to evaluate them in terms of cost, capacity, efficiency, and reliability.

One important prerequisite for the amateur is the capability-to-price ratio, plus sufficient ruggedness to stand up under daily use. I have recently secured a pocket programmable calculator that seems to offer the greatest capability for the cost of any on the market. In such a rapidly changing field, I should add — as of September 1981. The machine is the Casio FX602P, list price $130.

The machine weight is 3.5 ounces, in a package that measures 5.25" long, 2.75" wide and .38" thick. It operates on two lithium batteries that give a life of about 660 hours of continuous operation.

The calculator has combined program steps plus 512 program steps and 22 memories, or combinations of the two down to 32 program steps and 88 memories. It allows parenthesis nesting up to 33 levels, and up to nine nestable subroutines are available. It also has continuous retention of both programs and memory when the machine is turned off — a prime prerequisite for today's machines.

Up to 10 programs may be entered and recalled in the machine. With the 512 steps, this means you can put a great deal of program material into the calculator for instant recall. The program form is algebraic, the same type used by the Texas Instrument calculators, so programs written for their machines can be adapted to the Casio.

Although the Casio has the language of the Texas Instrument calculators, due to merged functions, its capacity is greater. A TI program for optical design using 381 steps and taking 67 seconds to run needed only 279 steps in the Casio and it ran in 32 seconds! On this basis, the Casio has the equivalent of 700 program steps in a TI-59 in its 512 step listing.

An important feature of the Casio FX602P is its accessory FA-1 tape adapter, listing for $39.50, that enables one to record both program and memories onto any tape recorder and to recall them at any time. Having worked with recorded magnetic cards on Hewlett-Packard and TI calculators, I find the tape method easier and there is no problem of greasy cards not running. Recording or programming takes less than 30 seconds, and the number of programs that can be stored on a 90 minute tape is amazing.

Another feature of the tape adapter is that one can program it to play music. Incidentally, the power for the tape adapter comes from the batteries in the calculator, so no extra power sources are required.

The FX602P can display alphanumerics so you can program it to prompt you to be sure the proper data is entered. The programs and answers can also be labeled to make their use by another person easier. Programs can also be protected against their being copied by unauthorized persons.

I have developed a program for finding azimuth and altitude with the FX602P, with the unused memories being used to hold coordinates for 35 objects. One literally has a personal almanac for an evening's observations. This program will be listed in a coming issue of TM.

For size, capacity, versatility, I recommend the Casio FX602P from personal experience in both operation and program writing. It is a Best Buy for the amateur astronomer and telescope maker.

Computer Ray-Trace Program

A popular activity for the computer enthusiast is ray tracing optical systems to determine the errors and how they relate to acceptable tolerances. Mr. William T. McKinley of 3822 Shelby Rd., Lynnwood, WA 98036 has submitted programs for this purpose which, for a complete analysis, use conic skew rays and run off the popular TI-59 calculator. A program in BASIC that runs on the TRS-80 computer is also included.

These programs have been run on the TI-59 and on the TRS-80 and no apparent errors in the programs have been detected.

Program #1. A program for the TI-59 machine which assesses spherical aberration; O.S.C. (Offense against Sine Condition); and chromatic aberration as well as the allowed tolerance for each aberration. The program will handle up to six spherical surfaces.

To get this program, a SASE long envelope with three first class stamps and 44 cents for duplication is required.

Program #2. A skew ray trace for conic surfaces written in two versions, the first for the TI-59 programmable calculator and the second in standard BASIC requiring 3K of memory. For a proper analysis of off-axis aberrations, a skew trace is a must and any analysis of a lens design requires such a trace to be valid. Mr. McKinley has described the skew conic trace in what he expects will be a simple explanation suitable for the amateur with minimum experience.

To get this program, a SASE long envelope with four first class stamps and copying costs of 60 cents should be sent to Mr. McKinley.

Note: Regarding postage, many people do not take advantage of the postal rates. Above one ounce, a lower rate applies for each extra ounce. Check your post office for what is the current situation and costs.

DOBSONIAN DEVELOPMENTS

Two years ago I joined our local astronomy club and was soon bitten by the aperture bug. I had always wanted a large telescope and dreamed of ultimately owning a ten-inch Newtonian. I devoured the *How to Build a Dobsonian Telescope* reprints from TELESCOPE MAKING and soon subscribed and sent for all the back issues. Ten inches of aperture no longer seemed an unrealistic dream.

Since that time I have built three Dobsonians, the latest using Coulter's 17.5-inch optics set. Many of the refinements which I "discovered" soon appeared in articles, independently invented by other telescope nuts. Clearly we Dobsonian enthusiasts are making many parallel developments!

I would like to share with my fellow readers a perspective on where the Dobsonian boom is today and where it may be ultimately headed. In addition, I would like to offer a number of refinements and embellishments to the basic Dobsonian philosophy, making it an even more attractive alternative to the classic equatorial Newtonian.

What Is a Dobsonian Telescope?

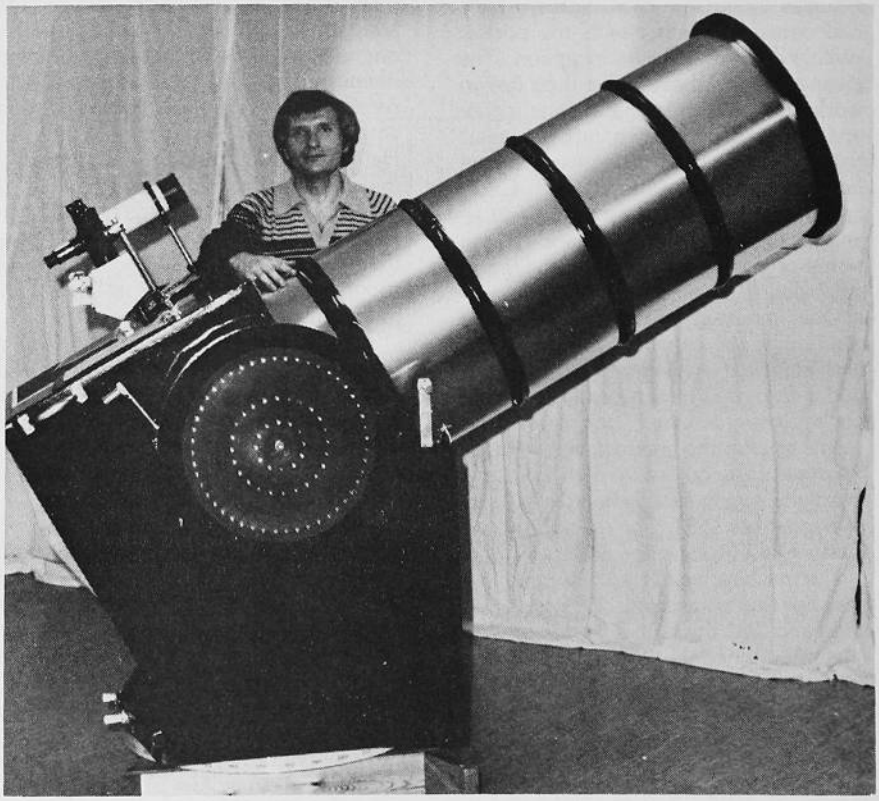
Optically, the Dobsonian telescope is a Newtonian of relatively short focal length and large aperture. Focal ratios of f/4 to f/6 are typical, as are apertures of 8 to 24 inches. However, it is the mechanical rather than optical configuration which really distinguishes the Dobsonian. The mount is a unique alt-azimuth wooden box construction and uses Teflon on Formica for bearings. A trap-door "tailgate" allows easy removal of the thin mirror, which is supported by a multi-point flotation and sling. The telescope inherits its name from John Dobson of the San Francisco Sidewalk Astronomers, who popularized and proved this radically new design. Every telescope nut with big eyes and a small budget owes John Dobson a permanent debt of gratitude.

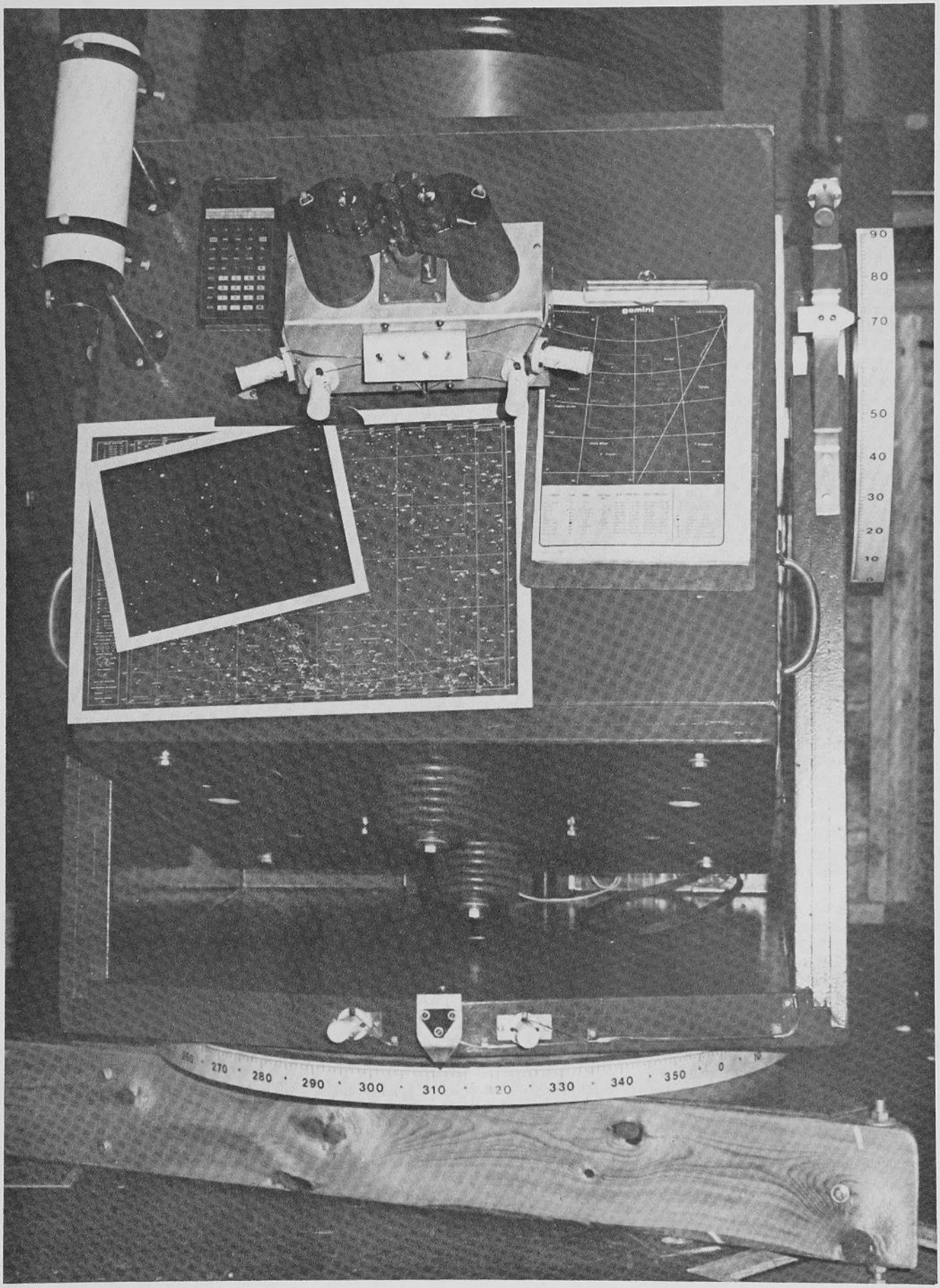
Past and Present of the Dobsonian

The pages of TM clearly reflect the history and current trends in Dobsonian telescopes. Many amateurs are building them, and the larger examples typically reveal added sophistication and modifications to maintain portability. The addition of wheels, multi-sectioned tubes, and lighter designs permit huge apertures to be transported with some degree of convenience.

The 24-inch size seems to be a realistic upper limit for the portable Dobsonian for two reasons: the sheer weight and size of the telescope become unwieldy. Long focal lengths even at low focal ratios require a precarious perch atop a tall ladder on some remote parking lot or field. The 18-inch range can more realistically be called truly convenient. This size can be transported in a station wagon and requires only one or two steps up to the eyepiece. Nevertheless, I'm sure we will soon see "portable" Dobsonians pushing against the 24-inch barrier.

At present we see complete Dobsonians on the market in the 8 to 18-inch range, with hints of even larger apertures to come. Amateurs are building their own mounts with fine optics available at low cost. However, in the very large size range, builders have

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encountered a scarcity of glass blanks and non-availability of moderately-priced large mirrors.

Dobsonian Advantages

The Dobsonian has several obvious advantages, and even more become apparent when you first use it.

LOW COST is the overwhelming advantage and attraction of the Dobsonian. The Newtonian has always offered most aperture for your dollar because of the simplicity of Newtonian optics. The Dobsonian takes this one step further by slashing cost of the mount. In addition, the alt-azimuth geometry permits use of a thin primary mirror, reducing cost further.

BUILDABILITY is another advantage. Plywood and Formica are available locally at moderate cost and require no fancy lathe or milling machine to work. Simple hand carpentry tools are all that are needed to build a perfectly functional mount with no special skills required.

PORTABILITY is another major advantage. Transport of a 12-inch equatorial Newtonian verges on the unrealistic. The Dobsonian allows portability in apertures exceeding 18 inches.

STABILITY of the mount on large bearing surfaces is superb. Motion is free of backlash, smooth and positive. "Hands off" warnings are unnecessary.

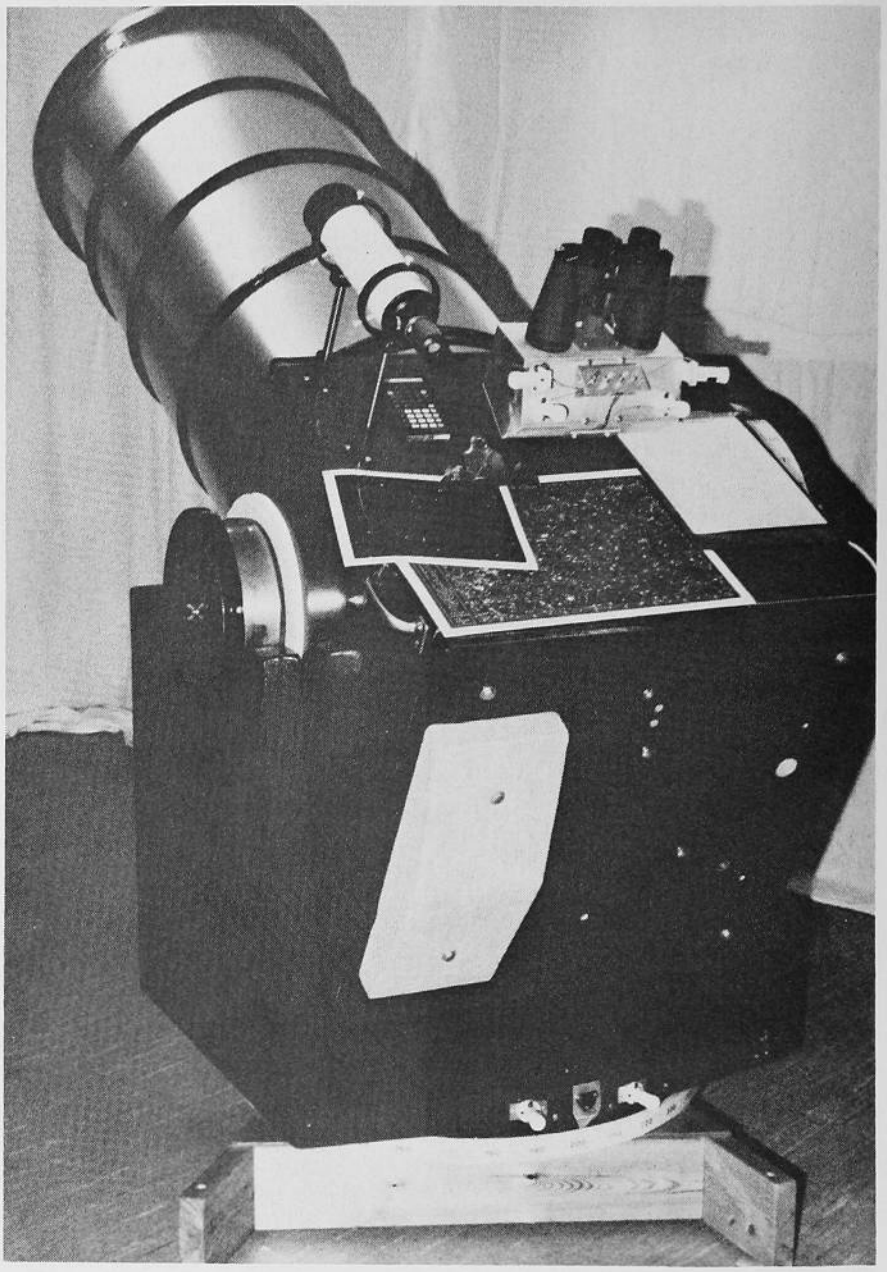
EYEPIECE ACCESSIBILITY is usually not mentioned, but an obvious advantage when you use the Dobsonian. Coulter's 13-inch Odyssey 1 is always accessible from a standing or sitting position. Moreover, the eyepiece is always horizontal, allowing comfortable, unconfused viewing. Tube rotation is never needed and the eyepiece won't fall out if you forget to lock it in!

FINDER AND ACCESSORY MOUNTING is easy on the flat top of the wooden tube box. Since the box moves in gravity-oriented, alt-azimuth coordinates, it is ideal for binocular finders. Charts and lights can be attached to its broad, table-top surface.

COMPACTNESS is appreciated when transporting. Not as obvious, however, the Dobsonian allows the most aperture to fit in a small observatory. The telescope tube is always symmetrically located at the center of the enclosure close to the floor. There are no awkward counterweights to trip you and no tall ladders to climb. When aimed anywhere near the zenith, the telescope allows free circulation of traffic around the instrument.

Dobsonian Disadvantages

If Dobsonians are so great, why hasn't everybody switched to them? The truth is that although the advantage list is impressive, the disadvantage list contains two major entries: difficulty in locating objects and difficulty in tracking

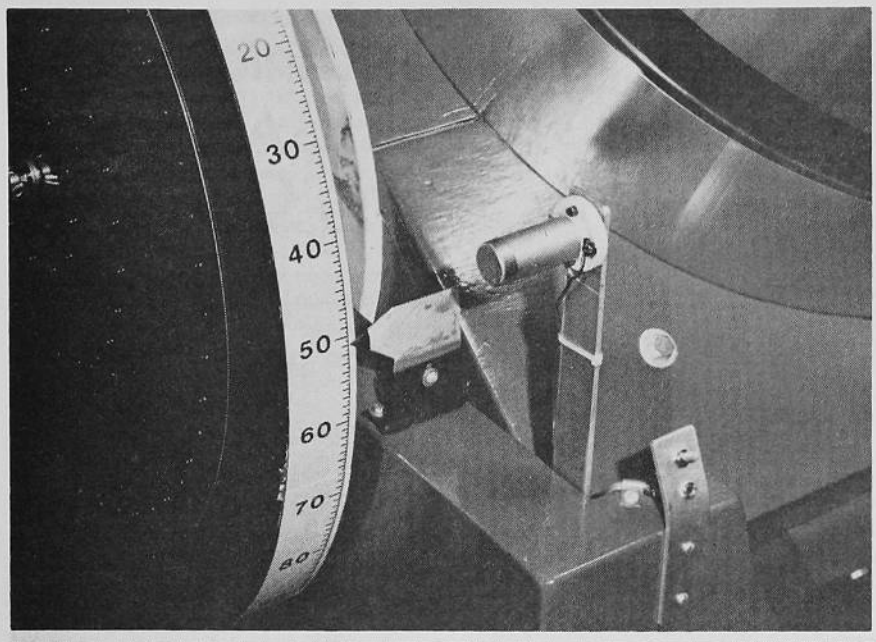


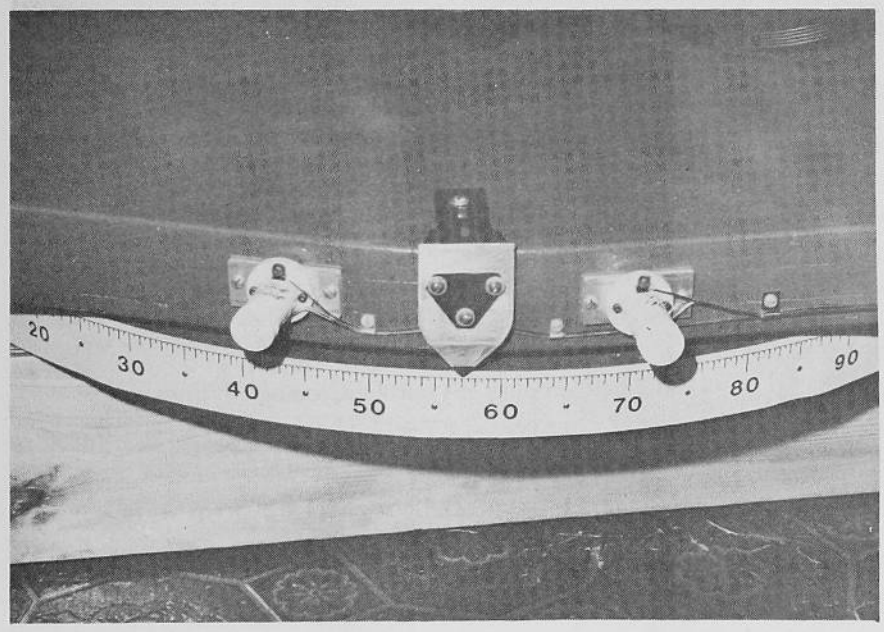
them. The alt-azimuth mount is at the same time the Dobsonian's salvation and curse. Every advantage listed above is either a direct or indirect result of the alt-azimuth mounting.

OBJECT ACQUISITION can be a real problem. The classical equatorial mount lends itself quite naturally to locating objects on the celestial sphere. Right ascension and declination can be read directly from setting circles on the polar and declination axes. The Dobsonian has no such obvious correlation between mount rotations and celestial coordinates. Nevertheless these relationships do exist and are easily handled by any programmable pocket calculator in about ten seconds. Articles in December 1978 and April 1982 ASTRONOMY and TM#13 begin to address this problem. We will develop more generalized equations and techniques in this article.

TRACKING to counter the Earth's rotation presents the second major problem. There is no simple axis that we can latch onto on the alt-azimuth mount to follow the stars. Furthermore, the naturally stiff friction in the Dobsonian bearings would require relatively powerful drive motors. If we attempt to drive both altitude and azimuth to track the stars, non-linear drive rates for both axes, simultaneously, would be required. In addition, non-linear image rotation would have to be added for celestial photography.

If that's not enough, consider that drive correctors would be needed for all three motions. And for good measure, the required two reference stars would have to be extremely close to the target





field to prevent residual differential image rotation. The three simultaneous non-linear drives could most realistically be handled by powerful DC stepper motors, all under computer control via a multi-programmer interface. But this challenging proposition is also expensive and goes counter to the whole Dobsonian philosophy. Although this can all be done in principle, it is clearly not a realistic solution for the amateur.

Fortunately, tracking does have a feasible solution: the equatorial platform, as expanded on by Richard Berry in ASTRONOMY's January '82 Equipment Atlas and Dick Houskeeper's article in TM#14. The Dobsonian telescope can be mounted bodily on one of the several platform variations and reliably track the celestial sphere for up to an hour. Now only a simple linear drive of the polar axis is necessary, as on any equatorial mount.

Tracking still remains a bit of a problem. On the standard equatorial mount, right ascension and declination are geometrically orthogonal, that is independent in terms of correction. On the platform-mounted Dobsonian, we have no such neat set of correction axes, at best, only a partial declination correction as outlined by Richard Berry in TM#14. We could correct altitude and azimuth with powerful synchronous motors. In this case, corrections would indeed be orthogonal, but clearly the variations in the platform motion would be awkward to follow. Any anomaly in right ascension would have to be corrected by a zigzag motion using both motors.

Another solution, but one not particularly satisfactory, is to provide three drive correctors for right ascension, altitude and azimuth. The RA corrector is always used. Of the other two, whichever is most orthogonal to RA would be used. For example, near the meridian, altitude would be used. Low in the east or west, azimuth would be used. The angle between correction axes will then always exceed 45 degrees, and should be nearly as convenient as classical equatorial correctors. Of course photography near the zenith should be avoided, since a discontinuity in coordinates occurs there, just as the classical equatorial experiences a discontinuity at the celestial pole. In addition, the platform must be precisely aligned and driven if it is to track fairly accurately. If not, cumulative corrections in altitude and azimuth will result in residual image rotation.

Making Setting Circles for the Alt-Azimuth Mount

Altitude is conventionally measured in degrees above the horizon. Altitude angles thus start at 0° at the horizon and increase to 90° at the zenith. Azimuth is conventionally measured in degrees from north, going through east, south, and west. This left-handed parity is counter to the usual right-handed system of the mathematician, but is nevertheless the universally-used convention for the astronomer.

The budding telescope maker is usually puzzled why books like *Amateur Telescope Making* devote entire sections to methods for making setting circles. It is really a question of accuracy — typical inexpensive store-bought scales are not uncommonly off by as much as a degree, or twice the angular diameter of the Moon! Combine this with the myriad of other sources of small error, and your "located" object can be uncomfortably far out of the field of even a low-power eyepiece.

More expensive scales such as protractors for the professional draftsman are accurate, but too small to read comfortably at the telescope in subdued light. Verniers only aggravate the problem. The ideal scale should be accurately ruled to 0.05° tolerance, should be as large as possible, and have bold markings every 0.5°. A circle diameter of 24 inches is not unreasonable, especially on a large Dobsonian. Constructing such a scale mechanically is no easy task.

Fortunately, it is no longer necessary to revert to mechanical techniques to make superbly accurate scales. Computer-controlled drafting machines are perfect for the job. The scales on my three Dobsonians were all generated using the HP9825 computer coupled to the HP7225A plotter. As a further refinement, the computer is instructed to

Dey's Technique for Using Alt-Azimuth Setting Circles

Set-Up

Pre-conditions:

- mount leveled
- mount aligned
- latitude known
- local clock time
- approximate date
- circles need not be oriented

Part 1 — Orienting the Circles (Sighting on Polaris)

Note the DATE and local time, T. (Neither need to be accurate.) Aim at Polaris and slip circles to read ALT and AZ according to the following computations:

A - 15*T - 0.985626 (DATE - March 21)
+ 15 (if daylight savings time)→theta

LAT - B*cos(theta)→ALT

-B*sin(theta)→AZ

where: T is local time in hours measured from noon, e.g., 8:30 p.m. becomes 8.5; 1:20 a.m. becomes 13.3333.

DATE is measured in days from March 21, e.g., April 6 becomes 16; September 12 becomes 175; February 4 becomes 320.

LAT is your latitude in decimal degrees.

A and B are parameters per the following table:

epoch	A	B
1980	212.9	0.83
1990	215.3	0.78
2000	218.0	0.74

Both circles are now properly oriented.

Part 2 — Determining the Temporal Constant K (Sighting on a Reference Star)

Our technique does not require accurate knowledge of the date or absolute time. This step gleans the temporal constant directly from a sighting on a reference star.

Choose an appropriate prominent star of known RA, — preferably in the east, west or south and not too close to the zenith or horizon. Aim at it and determine its altitude (ALT) azimuth (AZ) and local reference time (TØ) from the circles and the clock. Then compute temporal constant K using:

90° - LAT→G

cos(AZ) * cos(ALT)→X′

-sin(AZ) * cos(ALT)→Y

sin(ALT)→Z′

X′*cos(G) - Z′*sin(G)→X

ATAN2(Y,X)→HA

15*int(RA) + 0.25*fract(RA)→RA

HA - RA→K

where: ATAN2 is the unambiguous arctan function available in FORTRAN or constructable using the P↔R conversion on your calculator.

RA is right ascension, expressed in hours and minutes, e.g., 03h 32m 30s becomes 3.325; 12h 00m 20s becomes 12.0033; 4h 02m becomes 4.02.

You are now "set up" for the night and can either "locate" objects of known RA and DEC or "ident" objects of known ALT and AZ using equations in the following section and your set-up parameters K and TØ.

Object Location or Identification

Part 1 — Location of an Object

Given RA and DEC at Time T
Compute ALT and AZ using:

90° - LAT→G

15*int(RA) + 0.25*fract(RA)→RA

RA + K - 15*(T - TØ)→HA

cos(HA) * cos(DEC)→X

sin(HA) * cos(DEC)→Y′

sin(DEC)→Z

X*cos(G) + Z*sin(G)→X′

-X*sin(G) + Z*cos(G)→Z′

arcsin(Z′)→ALT

ATAN2(-Y′,X′)→AZ

where: DEC is declination in decimal degrees.

Part 2 — Identification of an Object

Given: ALT and AZ at Time T
Compute RA and DEC using:

90° - LAT→G

cos(AZ) * cos(ALT)→X

-sin(AZ) * cos(ALT)→Y′

sin(ALT)→Z

X*cos(G) - Z*sin(G)→X′

X*sin(G) + Z*cos(G)→Z′

ATAN2(Y′,X′)→NHA

NHA - K + 15*(T - TØ)→RA

int(RA/15)→W

W + 0.04*(RA - 15*W)→RA

arcsin(Z′)→DEC

The reader with a reasonably sophisticated pocket calculator, such as the TI-59 or HP-67, can program the above equations and store them on the little magnetic cards these calculators take. I have found that set-up for the night takes about five minutes. Subsequent location of objects takes only 10 seconds.

Sufficient capacity remains on the TI-59 to feed in tables of up to 40 objects for easy reference. A simple integer index and local time then immediately convert to ALT and AZ with the push of a single button. Calculation accuracy is virtually perfect, so your only limit will be the accuracy of the mount and circles.

purposely distort the altitude scale to compensate for atmospheric refraction as tabulated in the *Astronomical Almanac*. The computer inks the scales on poster board, which is subsequently attached to plywood or plexiglass disks and covered with clear vinyl. The scales can be read to 0.1°, and the telescope can be set with this same accuracy provided the mount itself has comparable mechanical tolerances.

Mount Alignment

Super-accurate setting circles can only be used to advantage on an equally accurate mount. The Dobsonian is easily capable of this with a little care in construction. The first requisite is a stable azimuth axis. Many alt-azimuth mounts have sloppy azimuth axes since they were never intended to be used with circles. You should use a stout steel pin, firmly attached to the ground board of your Dobsonian, and it should ride in a mating bushing counter-bored into the cradle and firmly epoxied in place.

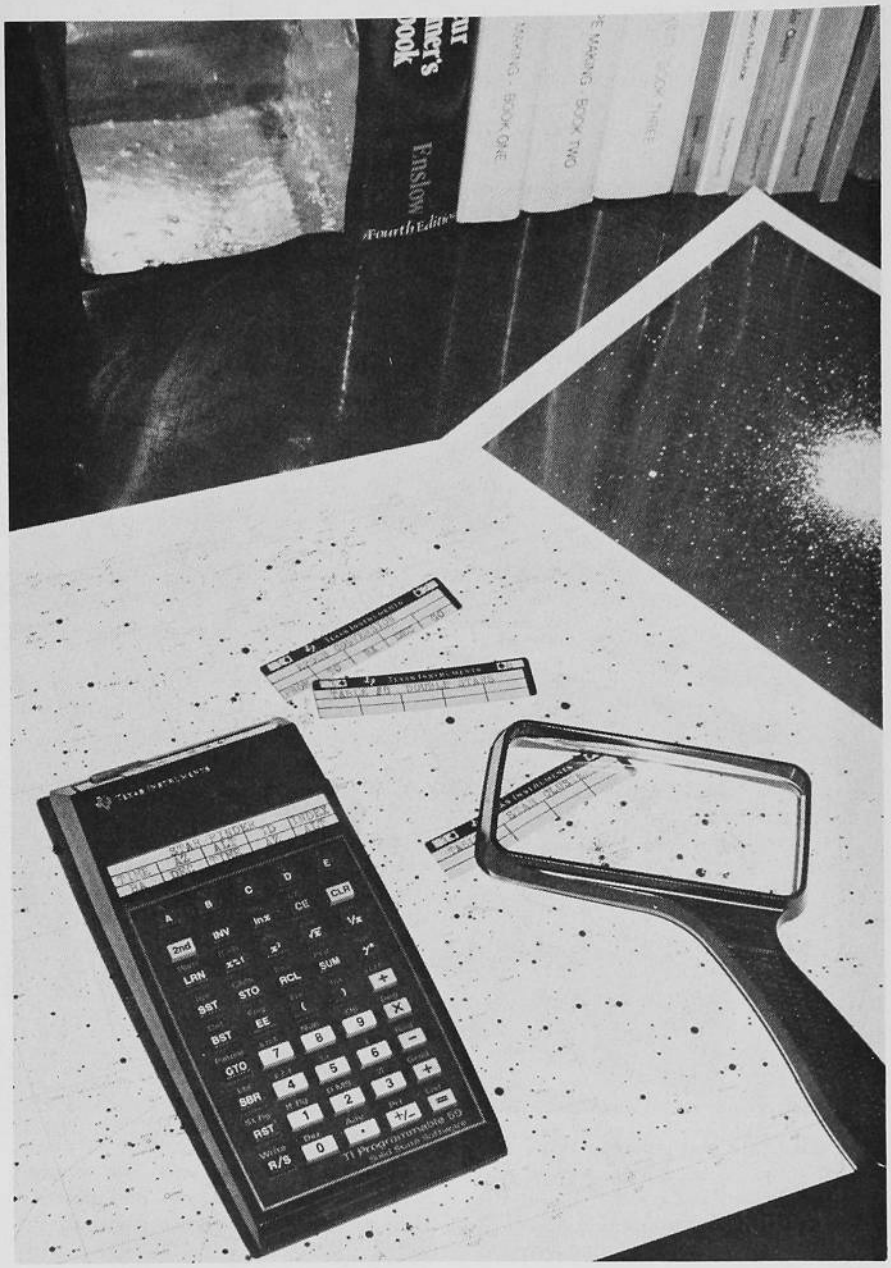
Care should be taken to assure that this stable axis is accurately concentric with your azimuth circle. If you are aiming for 0.1° setting tolerance, concentricity should be maintained to 0.01 inch when using 24-inch circles. This is easier to do than it sounds. Drill a hole to the pin diameter precisely in the center of your circle. The circle slips over the pin, accurately concentric yet free to rotate for set-up adjustments. The altitude axis is self-seating on the Teflon pads and therefore naturally free of wobble.

Circle alignment is achieved by a technique similar to that for the azimuth scale. It is now essential that you make the altitude axis perpendicular to the azimuth axis. Again, this is done more easily than it would seem. Simply measure the distances from the bottom of the rocker box to the side bearings on both sides. These distances should be made equal by shimming the Teflon pads on the low side. On a 24-inch box, an accuracy of ±0.02 inch is needed.

Next, the azimuth axis must be accurately vertical; that is, the base must be level. This is accomplished by placing a carpenter's level across the bottom board and leveling it in two roughly perpendicular directions, say N-S and E-W, using shims under the feet of the ground board. For a 24-inch ground board, your thinnest shim should be 0.04 inch thick.

Now comes a usually neglected adjustment in all telescopes: the optical axis must be perpendicular to the altitude axis. This can be accomplished in one of two ways, mechanically or optically.

The mechanical technique requires that you remove the diagonal and drop a plumb bob to the center of the mirror



with the telescope pointing vertically upward ("drop" is meant figuratively here — don't let go of the string). The center of the mirror is made plumb with the center of the spider. A 60-inch focal length would require a ±0.05 inch accuracy on this adjustment. Optics are then aligned in the conventional way.

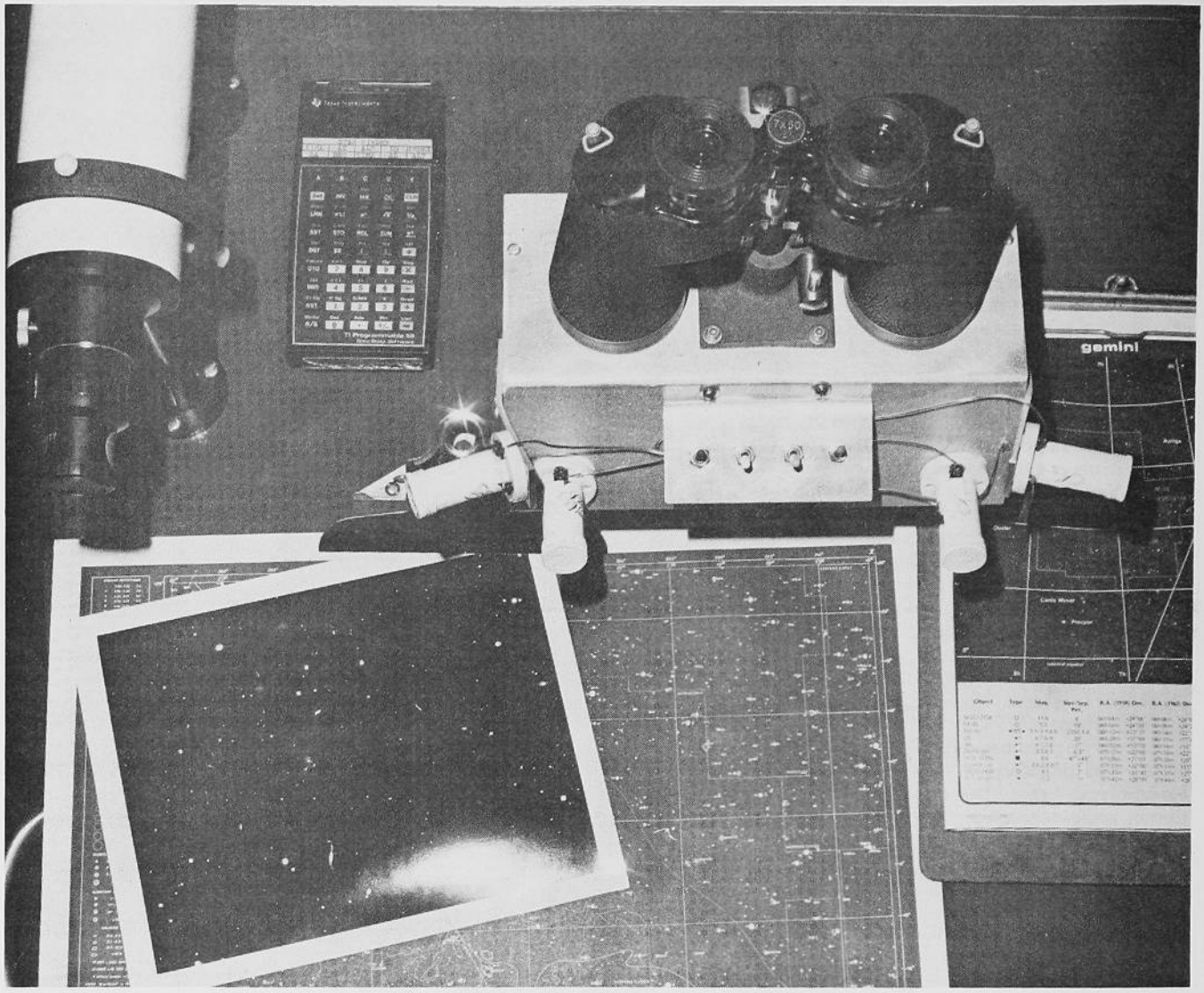
The optical technique is far more accurate. The telescope is aimed vertically upward with optics in place. A large flat mirror, which need not be of optical quality, is placed over the front end of the tube. A plate glass mirror is appropriate. Level this mirror by adjusting the tube altitude angle and shimming the mirror in a direction parallel to the altitude axis until a marble will not roll off its back.

Next, auto-collimate the focal point of the system using appropriate auxiliary optics at the focuser location (e.g., a beam-splitter, light source and cross hair). This is achieved by adjusting the spider position transversely to the tube axis until the image of the source falls on the cross hairs. Autocollimation is only necessary in the direction parallel to the altitude axis.

Using Setting Circles

There are a number of valid ways to locate celestial objects using setting circles with the alt-azimuth mount. They differ in the amount of *a priori* information available and the amount of computation required.

The method requiring the most *a priori* information and the least computation is described in ASTRONOMY's Equipment Atlas in December '78 and April '82. To use this method, one must know the latitude,



longitude, date and universal time. The mount must be accurately leveled and aligned. Under these conditions, the RA and the DEC of the celestial object of interest can be immediately converted to ALT and AZ using a straightforward coordinate transformation.

At the other extreme, there is a method requiring the least *a priori* information, but much more computation. This technique requires only an accurately-aligned but not leveled or otherwise oriented mount. Neither latitude, longitude, date, nor universal time need be known — only local time from any clock is used. The clock must be consistent, but may be arbitrarily set for the night. Under these conditions, initializing sightings must be taken on two reference stars. This allows you to determine the level and orientation of the mount and to then reliably locate subsequent objects. The mount need not be aligned since the calculator is programmed to compensate.

The third technique, which I prefer to use, represents a compromise between the above two extremes. The mount must be accurately aligned and leveled, and latitude must be known. Local watch time is used as in the method above, and the date need be known only roughly. Set-up sightings are taken on Polaris and one other reference star. The date is used to compute the accurate position in altitude and azimuth for Polaris. The telescope is then aimed at Polaris, and the circles adjusted to match the calculator readings. Next, a prominent reference star is located, and corresponding altitude, azimuth and time entered into the calculator. The calculator computes the appropriate temporal constant. We are now ready to locate objects for the remainder of the night.

In this method, time, RA and DEC are converted to ALT and AZ as quickly as the first technique. I prefer this method because it requires the least *a priori* information, yet computes as fast as the best. The price is a moderate amount of interactive set-up.

A useful modification of this technique allows for unknown latitude, provided the altitude circle is accurately set. The telescope is then effectively used as a transit to measure latitude. If the telescope is permanently mounted, the initial set-up need be done only once.

Since this technique is new, I would like to provide the reader with sufficient detail so he can program his own calculator to locate objects accurately.

Finder Scopes

For a large Dobsonian, the ideal finder telescope should be mounted on the top of the tube box, in such a position that you can aim the telescope while comfortably viewing the star field. A right-angle deviation, as with a star diagonal, is clearly needed here. But the star diagonal has a serious drawback — it reverses image handedness, making interpretation of star charts difficult if not impossible.

I have overcome this problem by placing two mirrors in front of wide field 7 x 50 binoculars. The image is erect and of the proper handedness. The viewing

position is extremely comfortable, and the comparison star chart can be clipped directly to the tube box below the finder. The binoculars are easily attached or removed without disturbing alignment.

I find that cross hairs are unnecessary, although they could easily be added by directing a small collimator into one of the objectives without touching the binoculars. Some care must be taken in selecting mirrors for the finder adaptor. Select pieces of old-fashioned polished plate glass are frequently flat enough, but you will need to pick through quite an amount before you come up with adequate flatness. Unfortunately, all commercial "plate" is now produced by a tin "float" process and is not nearly as flat as polished plate. You can, however, produce your own mirrors of ¼" or ⅜" float glass.

Start with three ten-inch circles. Grind together in all combination, then polish the best on a well-supported felt pad. Flatness to two fringes on a two-inch test glass is adequate for this low-power application. The mirrors should be first-surface aluminized and cut to the appropriate size. They are arranged much as the faces of a penta-prism, each making an angle of 22.5° with the optical axis of the system.

Place one mirror on a hinged push-pull screw to provide for altitude alignment. The entire mount pivots in the plane of the tube box for left-right alignment. Not only do binoculars provide an ideal rich-field finder, but you will find the comfortable, right angle, rigid mount allows you to see much more than you ever thought binoculars could reveal. You will finally be able to really appreciate the Pleiades, Beehive, Hyades, and Milky Way without neck fatigue detracting from the view.

Mirrors

I am quite favorably impressed with Coulter's 13.1-inch Odyssey 1 and also their 17.5-inch optics set, and both telescopes can be pushed to high power with decent definition. Light grasp is, of course, impressive. As Bob Kestner's recent articles reveal, you can make even larger mirrors yourself if you can procure the glass.

Nine-point flotation seems to work admirably on these thin mirrors, and even thinner mirrors could undoubtedly perform well on eighteen-point flotations. I think we will see more of this before the aperture-boom finds some fundamental plateau beyond which progress is prohibitively difficult.

The Pleasures of Observing

My largest Dobsonian so far uses the Coulter 17.5-inch optics set. I find that the compact, squat mount easily fits within my 12-foot observatory with plenty of room remaining for observers, chart-table, and ladder. I purposely beefed-up the mount since it is semi-permanently located in the observatory.

Handles at the back of the tube box allow me to easily aim the telescope while viewing through the binoculars. Small lights illuminate the huge setting circles. After some days of fine-tuning the mount, I now can reliably locate objects to within 6 arc-minutes using the calculator and circles. The binocular finder is a real pleasure for simple sweeping to locate objects of interest.

The circles and calculator used in reverse allow me to identify unknown clusters, galaxies, or nebulae. The huge aperture really brings in quite obscure objects and is especially impressive on small nebulous targets such as galaxies and planetary nebulae.

I wasn't delighted that I couldn't afford the big equatorial Newtonian that I once had my heart set on. Now, through the Dobsonian revolution, I have more aperture than I had ever dreamed possible. Thanks to innovators like John Dobson and Bob Kestner, more amateurs than ever before are appreciating the splendors of deep-sky observing.

I believe that the Dobsonian boom is here to stay. The future will see improvements in setting circles, calculator programs and equatorial platforms. I believe we will see Dobsonians up to 36-inch aperture at permanent installations, using ultra-thin mirrors on sophisticated flotations. Clearly the sky's the limit!

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Nested-Corner Equatorial Platforms

If an equatorial platform is simple enough, it will become attractive for visual work and may appeal to a large number of users of Dobsonian telescopes. In addition, if it provides the ability to correct in declination as well as guide in R.A., it serves the astrophotographer, too. I believe my nested-corner platform, a variation on the Haig mount derived from the Bending Pier Mount of Graeme White in TM#14 might be the answer for owners of many alt-azimuth telescopes.

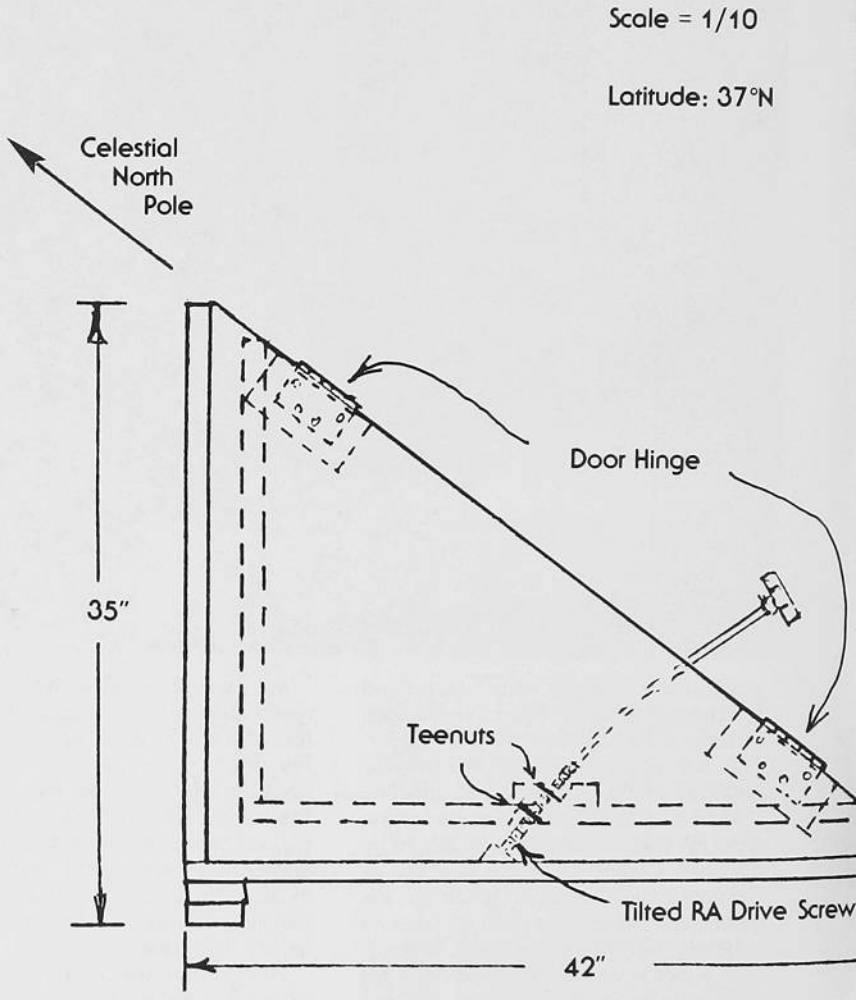
The dimensions shown are a bit large for the Coulter Odyssey I scope, but may be about right for the Odyssey II. It raises the telescope only 6 inches above its normal ground position. The limited tracking range — about 30 minutes — keeps the center of gravity of the instrument within the stable range but provides enough time to guide a photograph.

The corner configuration is rigid yet minimizes weight. All joints could be reinforced with angle iron as you use plywood less than 1" thick. Lightening holes could be cut in the triangular panels, but I'll leave them up to you — these details are the fun part of each individual design.

For the Odyssey I and II, I'd suggest building the platform reversed from the drawings, so the R.A. motion knob is on the west side of the hinge rather than the east side as shown. This will place the knob conveniently when you're observing near the meridian in the southern sky since the Odyssey's eyepieces are then on the west side of the tube.

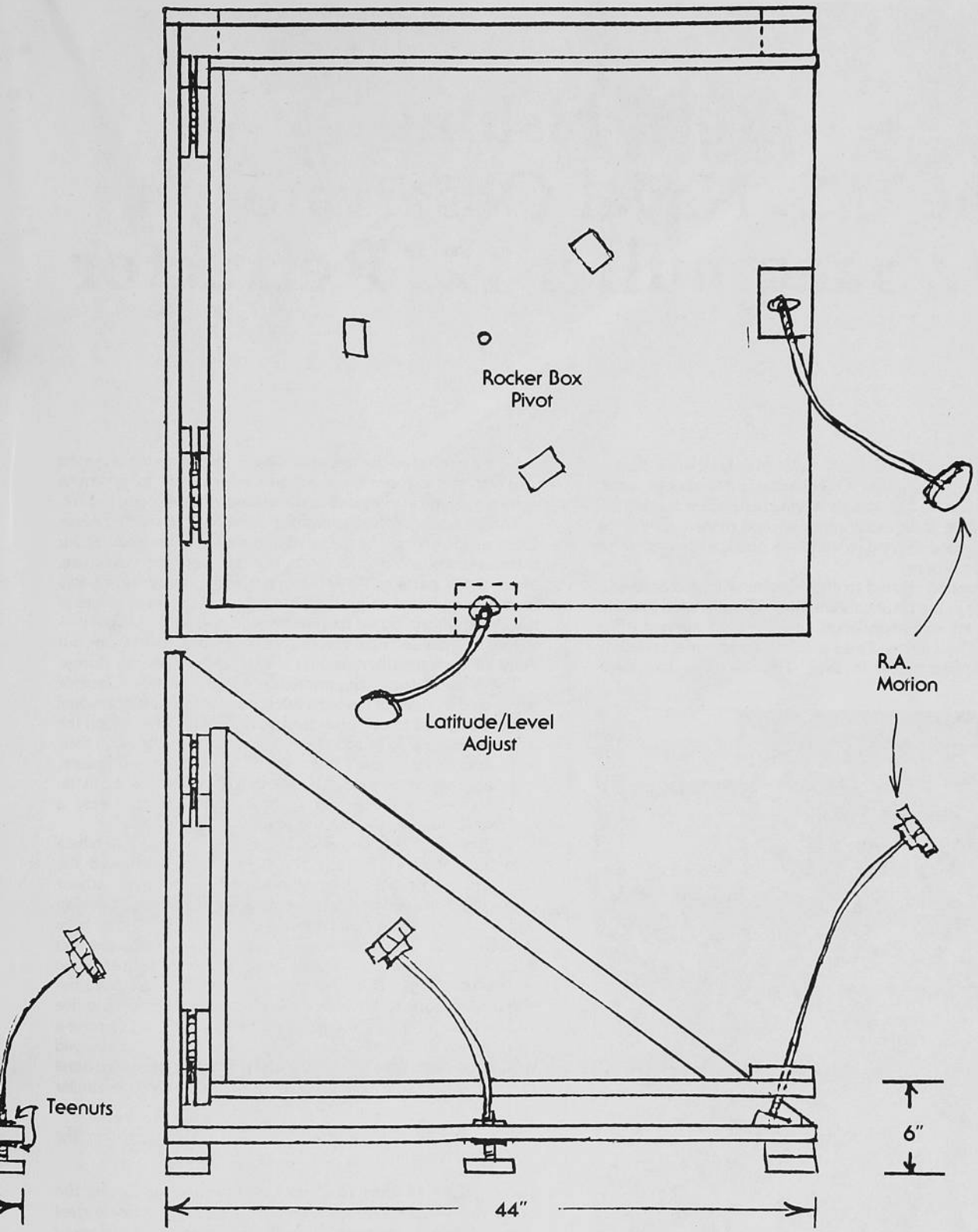
The leveling jack is shown with a flexible shaft for adjustment while observing. This is not a declination motion except at the meridian. If you need a better declination motion for astrophotography, you should consult "Dual Axis Equatorial Platforms" by Richard Berry in TM#14.

Since this platform emphasizes simplicity, the "rough approximation" of a declination motion is all you'll need. It can come in handy at times when observing the most favorable regions of the sky about the meridian.



The flexible shaft makes polar elevation alignment quite easy. You observe an eastern star while at the eyepiece. Of course, it also gives some latitude adaptability and makes leveling easy.

The hinge can be any heavy type, but



door hinges are very strong and compact. They also allow the hinged surfaces to go a few degrees past parallel so that the platform can "bottom out" at minimum separation of the jackscrew. With this arrangement, you get about 15 minutes of following time either side of "level."

The platform can be used to replace the ground board of the Dobsonian mount simply by adding three Teflon pads and a pivot hole at its center. You'll have to remove the pivot bolt and platform for transportation of the mount, though. This equatorial base must be quite a bit larger than the original base in order to provide adequate turning radius for the rocker box corners.

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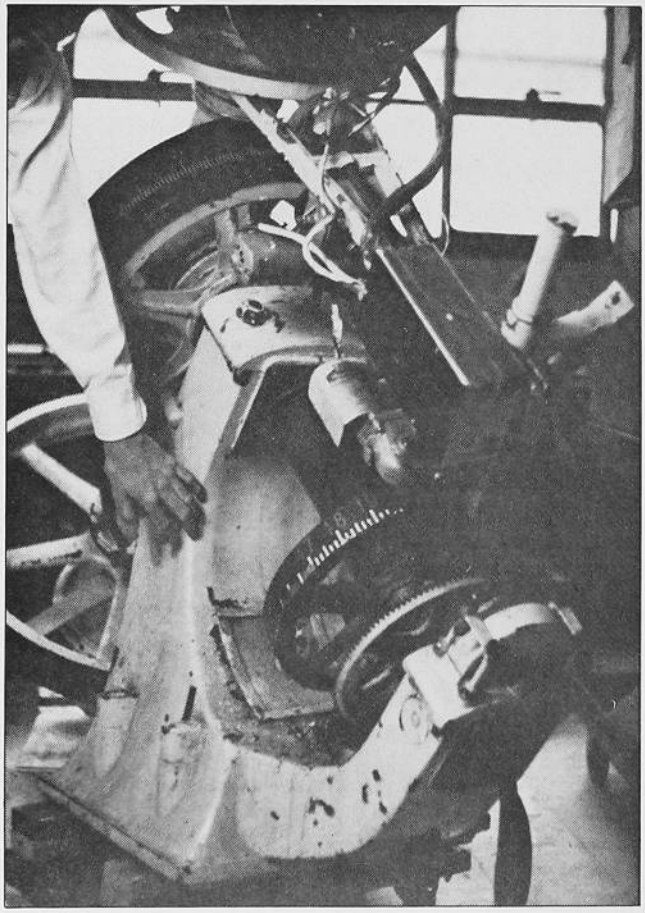
Refurbishing the U.S. Naval Observatory's 1892 Saegmuller 12" Refractor

At the U.S. Naval Observatory it was mainly all work and no play. On most nights, the Observatory's telescopes were engaged in specialized programs leaving no time for viewing for the pure fun of it. If an astronomer wished to view the Moon through a telescope, he had to wait for a public night and stand in line with the others.

But that situation started to change when Richard Schmidt, an astronomer in the Nautical Almanac Office, seeded the idea of returning an old abandoned telescope to service. The instrument he had in mind was a 12-inch equatorial refractor built by G.N. Saegmuller in 1892. The telescope had been removed from atop the main building of the Observatory in the 1950s to make room for a Moon camera used to detemine ephemeris time — a project that had been discontinued in 1974.



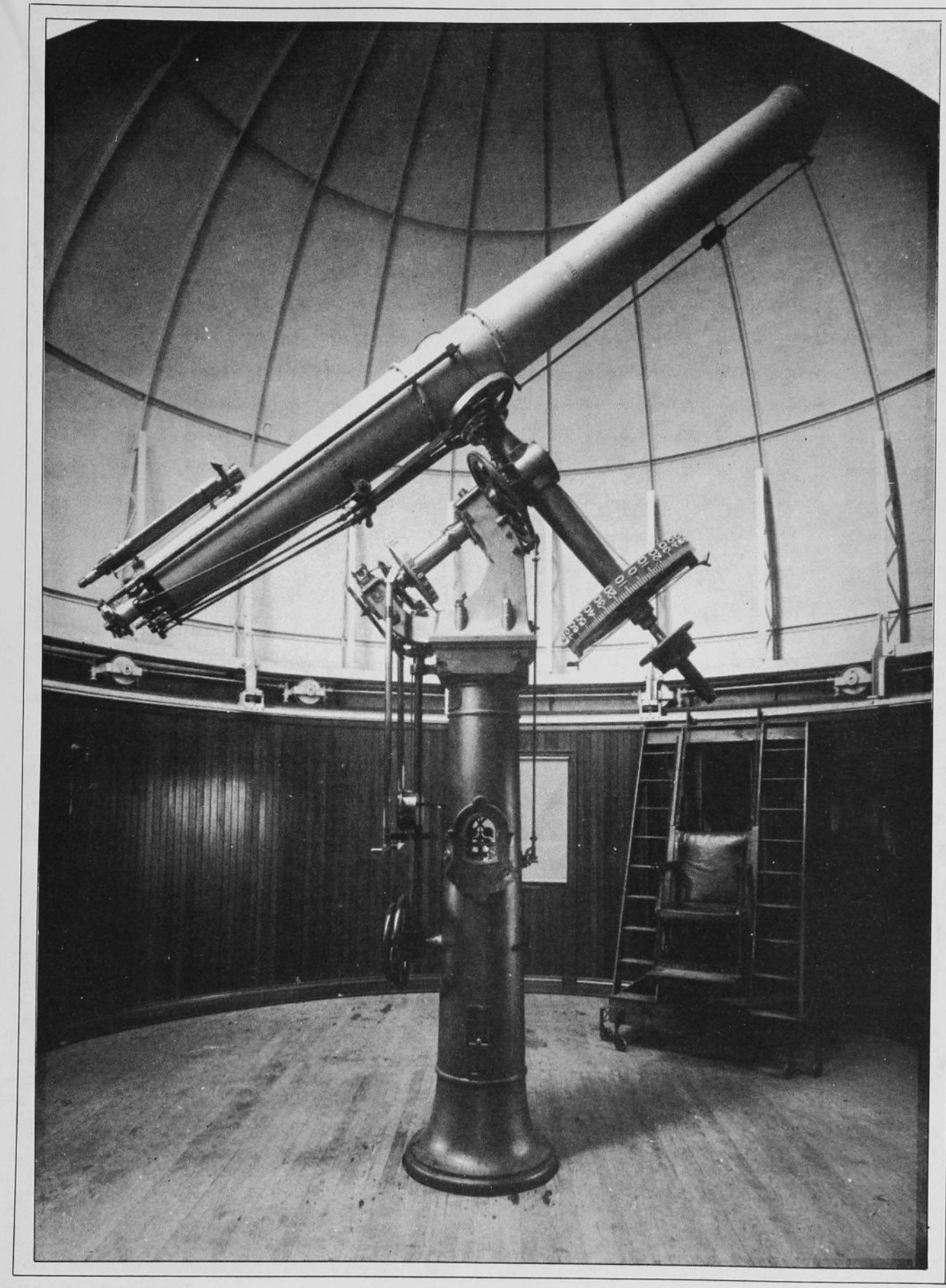
The affects of long years of storage are evident on the equatorial mounting.

The 12-inch equatorial as it appeared around the turn of the century. The telescope stands about 17 feet high inside a steel dome 26 feet in diameter built by the Warner and Swasey Company. The objective of the Fraunhofer-Herschel design has a 180.6-inch focal length. The driving clock was located inside the cast iron pier, and consisted of a weight-driven double conical pendulum. The two hand-wheels located on the side of the pier allowed an astronomer to set the telescope in both coordinates with the aid of two setting dials just above the wheels. The driving clock, hand wheels, and setting dials have been lost over the years.

The objective of the Saegmuller telescope, figured by Alvan Clark and Sons, had been tested and shown to be unsuited for astrometric photographic work, but excellent for visual use. Most of the parts of the mounting, though many were badly rusted, were found after searching numerous storage places at the Observatory. So we had a telescope and a place to put it — all that was needed now was to clean the parts, paint them, put them all back together, and lift it back into its former dome!

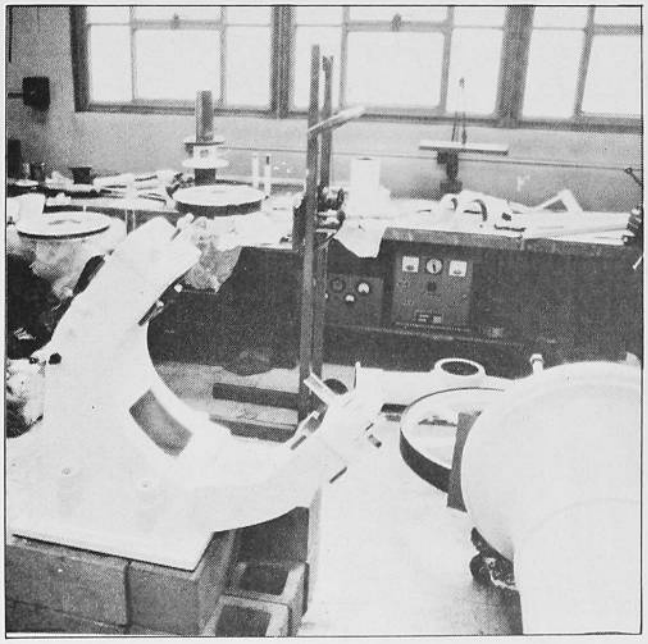
The Observatory's Superintendent and Scientific Director supported the idea of having a telescope for the staff's personal use, and agreed to our proposed volunteer effort in which the astronomers would put the telescope back into shape on their own time. The Observatory would provide a workplace, supplies, and some money for restoring the telescope. So in the spirit of any good group of government employees, a committee was set up and the work began.

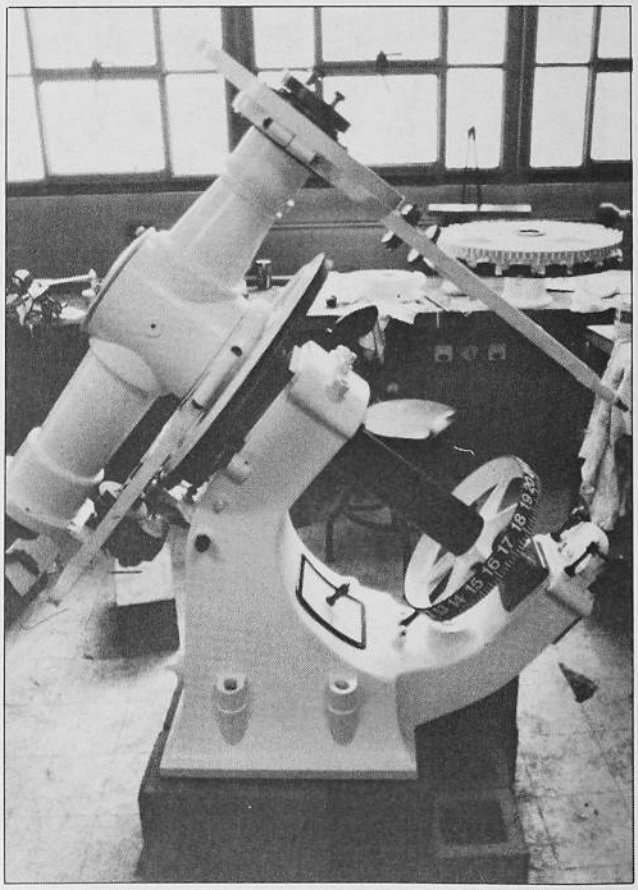
Refurbishing the telescope in Washington turned out to be a great advantage. The stripping company that removed the paint and rust from the largest pieces of the instrument without damaging the metal had done some work for the Smithsonian and was experienced at handling old items. The Navy Ship Research and Development Center repaired a major crack in the central tube section of the telescope as a training exercise — free of charge. The Washington Navy Yard provided the crane necessary to lift the pier and equatorial mounting five stories to its dome. The crane had been scheduled to raise a weather tower at the Observatory, a job which was delayed until the telescope parts were ready, then both jobs were done in one visit. Georgetown University operates a similar

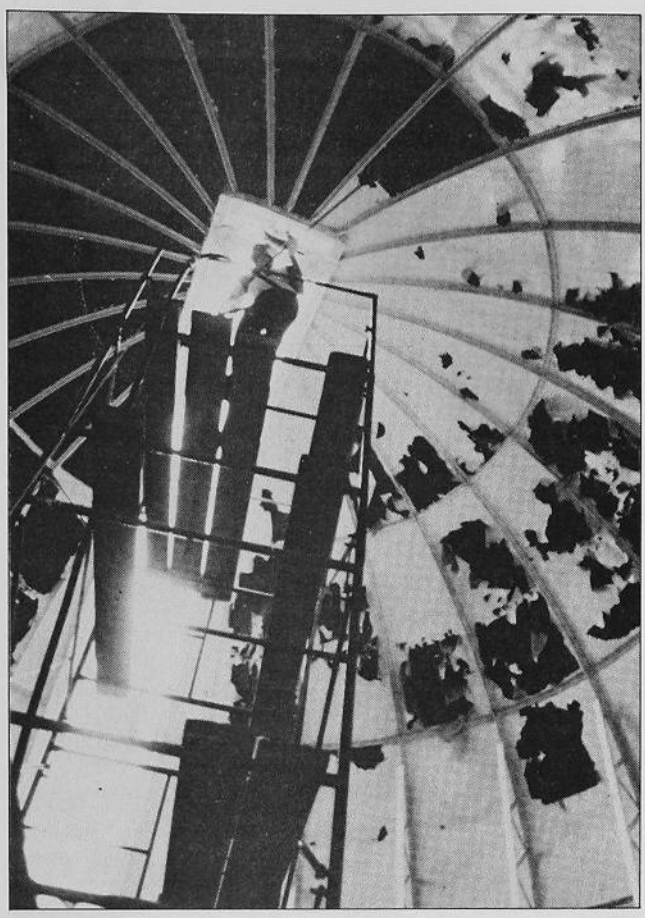


The largest parts of the telescope were taken to a local company for chemical derusting and paint stripping. The cast iron pier, pictured here, came out looking like new.

The work area where the telescope was cleaned and painted was often crowded with parts of the instrument. The equatorial mounting in the center of the room was assembled and disasssembled many times before we were certain that all the parts were fitted correctly.







Before the telescope was installed, the interior of the dome had to be cleaned and painted. Rich Schmidt is shown blasting old paint off the dome using a high-pressure air hose.

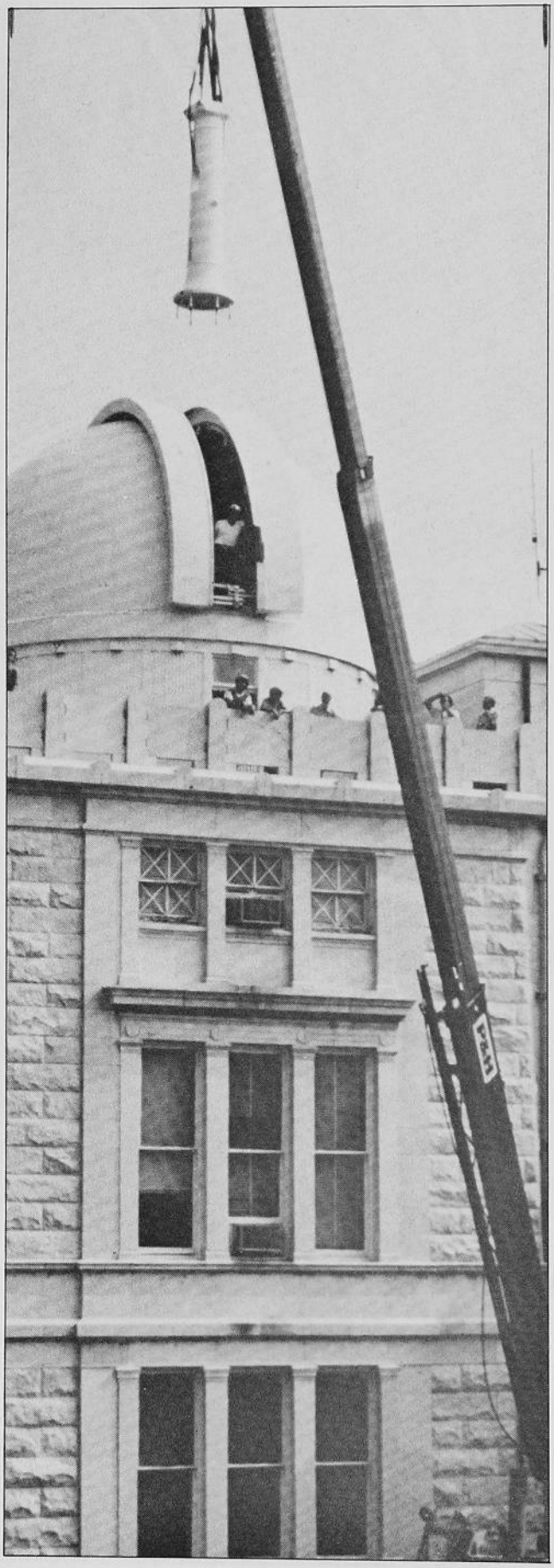
A crane from the Washington Navy Yard lifts the pier 59 feet to its original home atop the main building of the observatory. A small section of the shutter had to be cut back to allow the pier to fit through the opening.

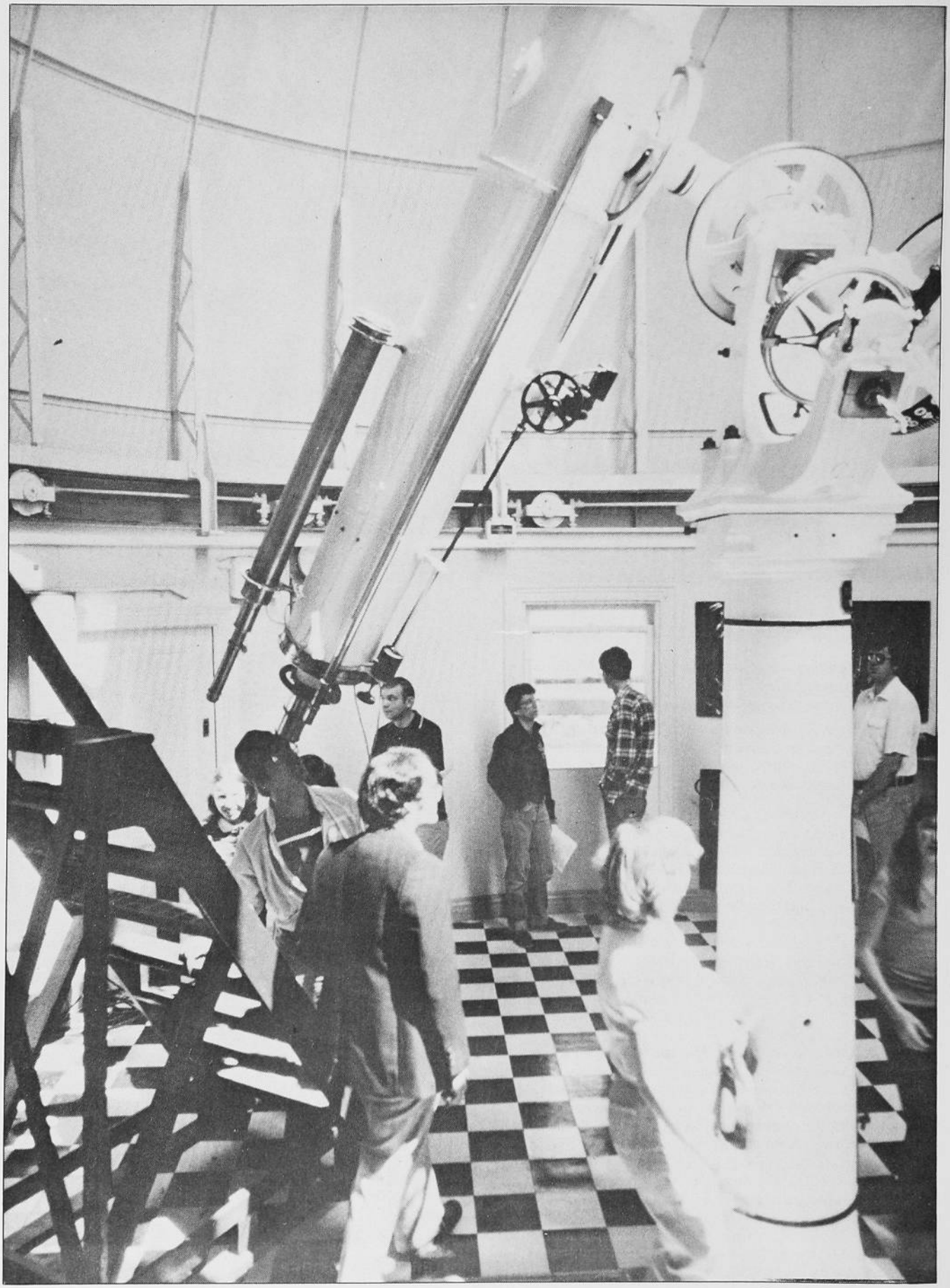
Saegmuller 12-inch refractor which we visited a number of times to see how certain parts were assembled. And, of course, the painters, electricians, engineers, and instrument makers of the Observatory staff were on hand and more than willing to answer questions and provide advice.

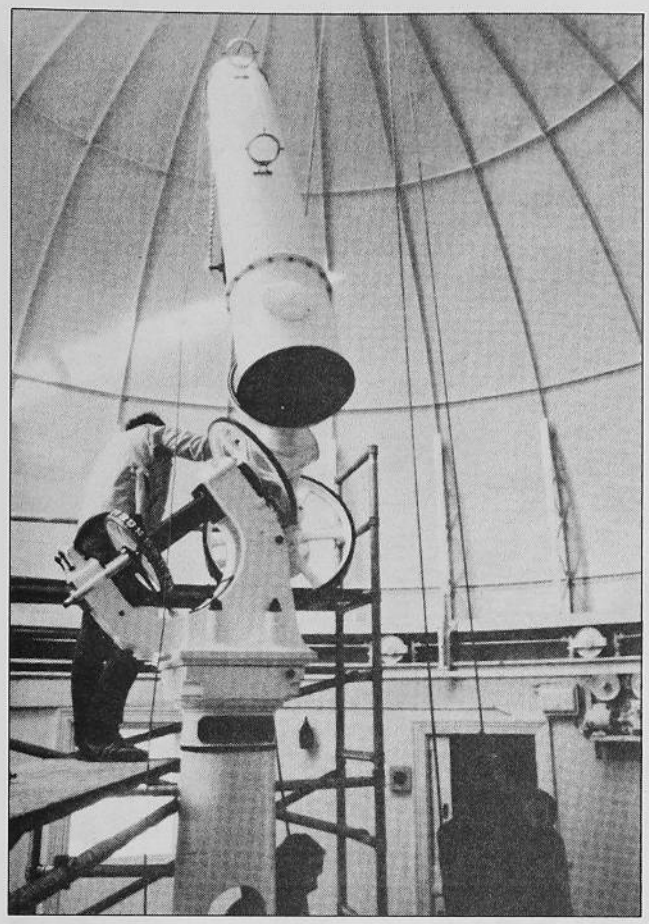
The telescope could not be restored to its original mode of operation since the manual devices for clamping and moving the instrument had been lost. The few motors and modifications we did add were kept simple in design and few in number — we did not want to have a complex instrument that the non-astronomical members of the staff would be unwilling to use.

In the span of one year, the telescope went from a state of decay to useful operation. Though the task was completed in the time planned, numerous problems plagued the project. The crack in the central tube section mentioned earlier made us wonder whether it would be wise to continue, since the weakened area lay where the declination axis connected to the tube.

Only one mechanical drawing of the telescope mounting could be found. With just that drawing, two photographs taken of the telescope at the turn of the century, and the Georgetown instrument, we did not always have enough information to deduce how certain parts went together. Many times we had the mounting almost together — only to find that it had to be







Assembling the tube of the telescope proved difficult since as each section was installed, the balance of the instrument would change dramatically. A scaffolding was used to support the counterweight of the declination axis while ropes held the tube sections.

At one of the open houses held at the Observatory, the 12-inch equatorial was fitted with a solar filter for the public to view sunspots. Rich Schmidt stands next to the observing ladder to operate the telescope and answer questions.

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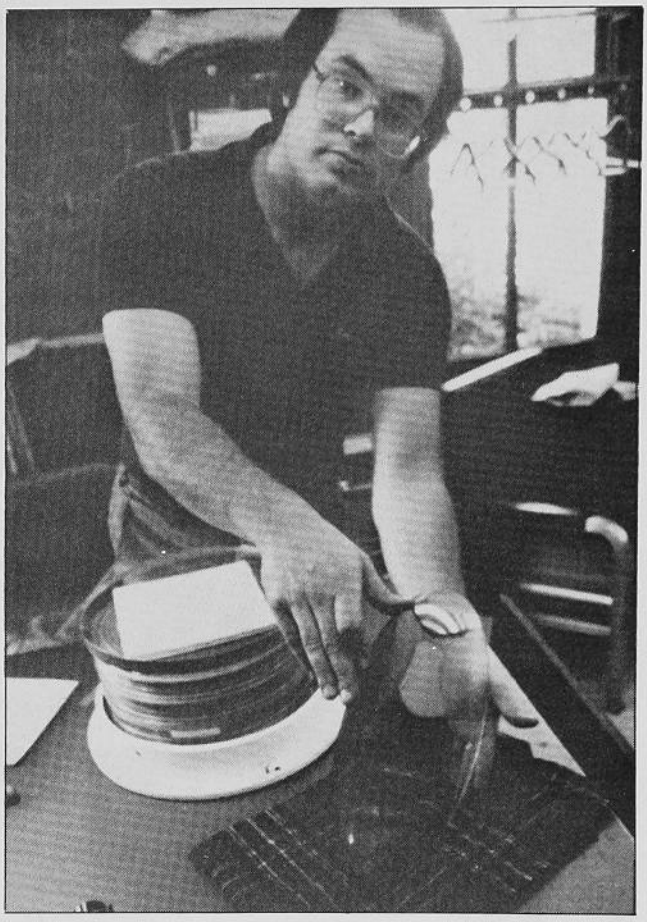
taken apart again because something did not work or because a piece had been forgotten. Once the larger pieces were raised into the dome, the other parts (some weighing over 100 pounds) had to be lifted in place by hand. Often a piece would be halfway in place only to discover that more help was needed.

Once the big parts were in place, we started troubleshooting the details. A number of motors for the telescope, for instance, produced more sparks and smoke than RPMs when first wired up. The clock drive motor, built in 1936, was rebuilt twice before it finally gave up the ghost just three days before the unveiling of the telescope to Observatory staff and members of the Saegmuller family. We quickly adapted another motor from a staff member's own telescope to replace it.

Another little crisis occurred when the slightly-deformed tube caused stresses on the cell of the objective lens, and one of the three spacers separating the two elements slipped to the center of the lens. The lens elements had to be removed and the spacers re-glued in place.

Even after those difficulties, the most frustrating problem was caused by two pigeons roosting in the shutter of the dome above the telescope. After numerous tries to keep them out of the dome failed, we put a scaffolding around the telescope and



Rich Schmidt holds the crown glass element of the 12-inch objective when the lens assembly had to be taken apart to re-glue the spacers between the elements.

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someone crawled on the top of the dome to install a screen around the sides of the shutter.

Finally, it was done. After hundreds of free man-hours of work and less than $500 spent, the Observatory staff had a telescope to use for the fun of it. We unveiled it at a rededication party with champagne cork-popping, live chamber music, and a few historical remarks about the instrument's makers by Deborah J. Warner of the Smithsonian. Over twenty relatives of G.N. Saegmuller attended the ceremony. The instrument is now included in the monthly public nights, open houses and many special tours.

In 1896, Dr. Henry Howe, Director of the Chamberlain Observatory in Denver, wrote the following about another Saegmuller refractor:

"When an astronomer's eye first rests upon a great telescope, with which it is to be his good fortune to storm the sky, his sensations are of the liveliest character. The mass of steel, iron, and brass which confronts him speaks eloquently of the patient ingenuity of the mechanician who calculated the form and dimensions of each of the hundreds of pieces of metal which joined in the intricate mechanism, and subordinated them all to one great purpose."

Those people who helped with the refurbishing of the 12-inch refractor can truly appreciate those words and the workmanship of the instrument's maker.

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U.S. Naval Observatory
Washington, DC

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Where to Find Parts for Telescopes

Somewhere in *ATM-1* it is written that in making a telescope the mirror is half the job — the other half is the mount. With thought, perseverance, a minimum of supplies, and your bare hands you can make a mirror which deviates by less than a millionth of an inch from perfection. However, mounts often seem to be built to standards where the tolerance is ⅛". I will not mislead you: in my opinion, to make a mount worthy of first class optics requires at least a lathe. If you do not have one and cannot beg or borrow one, you have a problem. On the other hand, if you can make good mirrors you should have little trouble finding a machinist who can make mounts but not mirrors. Therefore, let's just take it for granted that one way or another your mount will do justice to your optical skills.

Motors, gears, and other elements of a mount are, however, beyond common machine shop tooling abilities. This is not to say that you must do without. I have made telescopes using components which meet the highest standards and originally cost hundreds of dollars — for example, Globe DC motors, Bodine and Hurst AC motors, Baldwin Position Indicators and much more. I have bought these items, not for 10 cents on the dollar but for a fraction of a cent on the dollar. They didn't just fall into my hands; it took some effort on my part. I had to study the literature, seek out people who know more about these things than I do, do some moderate traveling (on weekends) and exercise patience. Why patience? Well, I have never started out to buy exactly what I needed and found it immediately. To do what I do you have to do your homework, place yourself in position, and then wait for the bargain to present itself to you.

If you have read this far you are now starting to think that if this is such a good thing, why is this guy telling me? Surely he doesn't want competition for all these treasures. Such is not the case — after nearly thirty years of mining this mother lode (I started when I was 12), I have become convinced that it will never become exhausted. The more I look, the more I find. Where do I look? At the Hamfest, a truly American phenomenon. Here, radio amateurs gather to recycle the castoffs of industry and the military. Thirty years ago these events were infrequent, but today on any weekend from February to November there is probably one within driving distance. Most have a hundred or so sellers, but a few of the really big ones have thousands. But I digress . . . so let's get on with your education!

Haste Makes Waste

Before we get too far, I want to caution you. It is very possible that you will find a treasure on your very first hunting trip. The pressure to spend too much can be overwhelming. It is easy to think that the seller really knows the "true" value of what you want and that you must pay dearly to get it.

Stop!

Almost without exception, this is NOT the case. Let's say that you have found a Globe DC motor. Originally it may have been attached to a vacuum variable capacitor or a variable inductor — the things that make a ham delirious. The motor is "junk," while the capacitor and inductor are "junque" to a ham. For you the relationship is reversed. Since there are 300,000+ hams and maybe 2,000 true-blue telescope makers, the odds are in your favor. On the other hand, if you are like me and have an interest in both telescope making and amateur radio then you really have to be careful to conserve your funds!

All That Glitters Is Not Gold

Unless the item that captures your eye is in its original carton (and a surprising number are), do not automatically expect that it is good. Let's take that Globe DC Motor again. It might say 28 VDC on the label, that is, if it has a label. How to test it? Since there are cars at these events, seek out an understanding owner (your car is usually on the other side of the lot). Lift the hood and touch the leads to the battery. It if will not turn on 12 volts, you can do without it. Simple? Sure — and if you think about it most of the mechanical and electrical items you will run into can be tested before you part with our money.

Should you become infected with the electronic bug in your quest for telescope parts, beware. When dickering for radios and test equipment, do not take the word of the seller that his goods work. I have been fooled by the most angelic faces and steady voices. Since I know something about electronics, I can usually cut my losses by fixing it myself.

Before you go off in this direction ask yourself: What's it going to cost to fix it if it does not work? Take that estimate and multiply times at least two.

The First Price Quoted Is Not Usually The Final Price

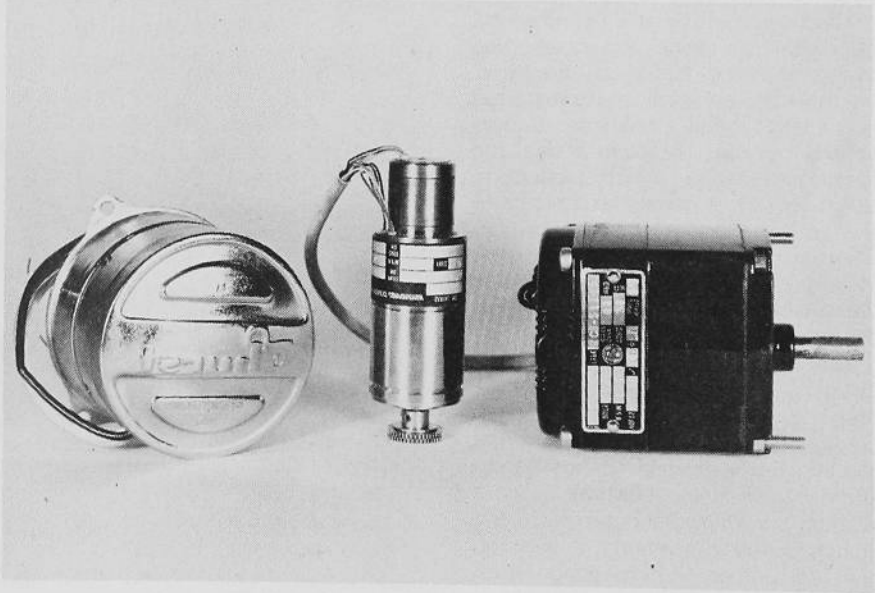
Haggling is a lost art in America. The supermarket and other mass market retail outlets have conditioned us to uniform prices. Not so the ham. While you will occasionally run into someone who will not budge on his first price, most will bargain. If you are quoted a price, try responding with half what he asks — or even less. Watch the seller's actions and listen to his response. Don't be intimidated! If you are facing a bargainer, it becomes a game of wits. Since you're playing for pennies on the dollar, it can be fun.

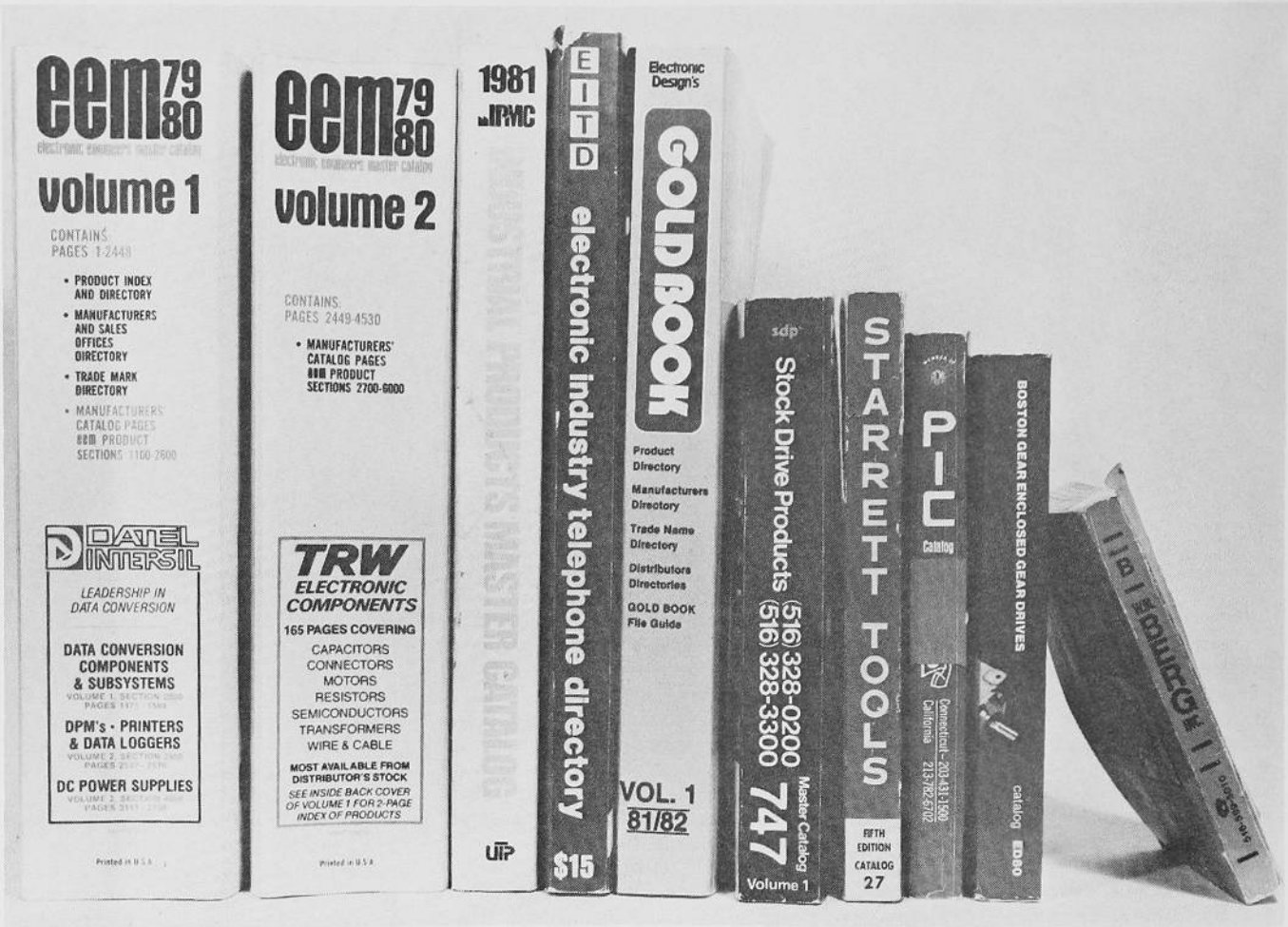
Now, if you get turned down flat, you must make a decision: will you swallow your pride and pay the asking price, or will you dig for gold some place else? My experience has shown that it's best to look elsewhere. I once saw an item at a gathering in northern Virginia which I could not get the owner to bargain down to $5. Two years later, in southern Ohio, the same person sold it to me for $1. Take note!

Where, Pray Tell, Are These Gatherings Held?

Your local newspaper is not a good guide to finding a hamfest. They are held in cow pastures, coliseums, parking lots, or fairgrounds to name just a few of the possibilities — hardly the kind of news event that sells newspapers. This is not a problem for hams because they have their radios for communication. However, within the past 10 years hamfests have become so numerous that the amateur radio magazines have created separate columns listing dates and places. There are four primary publications targeted at the Ham: *QST*, *73*, *Ham Radio*, and *CQ*. With the exception of *CQ*, which I have not read for years and cannot comment on, all publish this information and it is reasonably reliable. *QST* is the official journal of the American Radio Relay League and lists these events under a column "Hamfest Calendar." Some events are advertised in the classified section under the Clubs/Hamfest heading. This magazine, unlike the others which follow, is probably available at your local library.

For the others, you will have to find a local ham or the book rack in the local





electronic/TV repair parts store. *73* magazine lists hamfests under the heading "Social Events" and usually lists the current and coming month's schedule. There are no classified listings. *Ham Radio* magazine lists them as "Coming Events" in its Flea Market section.

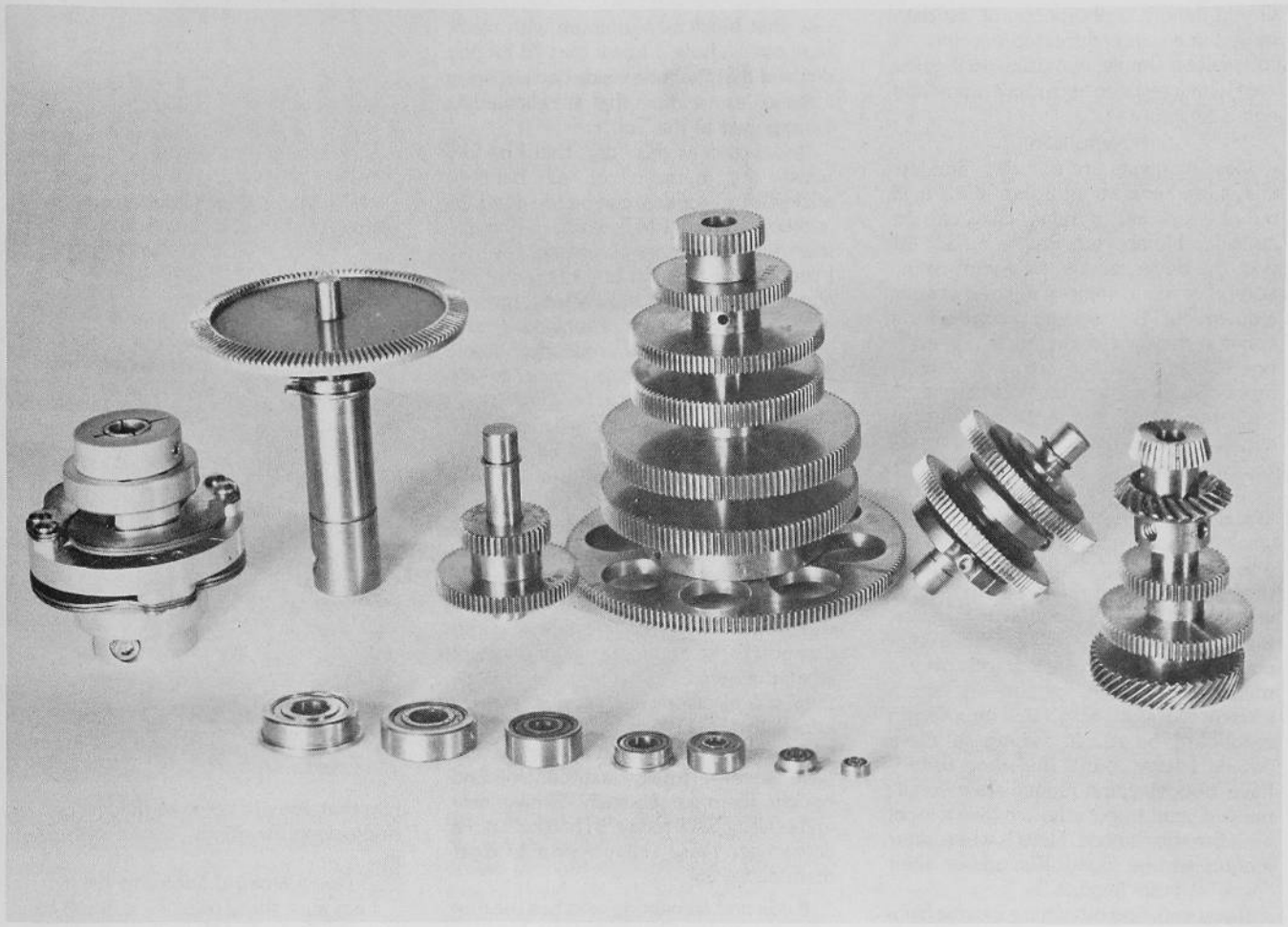
Where You Look Has Something to Do with What You Find

Ideally, you will be able to find a local ham who can guide you in selecting events to attend. Not all are the same, but those that are small tend to stay small year after year. Since a person can cover several hundred sellers in a day, the larger ones tend to be more productive, but there are important exceptions to this rule. The local economy can influence the "merchandise" offered. Military surplus has declined over the years while the share from industrial sources has grown. However, if the fest is near a major military base or supply depot, there is likely to be a preponderance of military surplus. Economic swings also play an important function in the flow of surplus goods. During hard times, business reduces inventory, sheds warehouse space, and dumps obsolete inventory it was too busy to bother with in good times. Therefore, knowledge of what is made in an area and by whom can be indicative of what you will find at a hamfest in that locality.

How Do I Recognize What It Is That I Am Looking At?

Merchandise at a hamfest is seldom displayed in an orderly fashion. If it is, it is probably too expensive for you — that order costs money. What you want will be in a pile, and probably at the bottom of a box. Initially you probably will not even know what you are looking at. To gain knowledge, you need some books and a period of study. As you make your study ask yourself how the products described can be adapted to telescopes.

Obviously a mention of shaft encoders



doesn't mean too much unless you know how they work and need to know where your telescope is pointed. I have found that the best place to get this information is from catalogs. They need not be current since most of what you will find at hamfests will be at least several years old. Some can even be found at hamfests! Here is my list:

Boston Gear Mechanical Components
Boston Gear Division
14 Hayward Street
Quincy, MA 02171

PIC Gear
PIC Design
Box 335, Benrus Center
Ridgefield, CT 06877

Starrett Tools
L.S. Starrett Company
Athol, MA 01331

Handbook of Small Standardized Components
Stock Drive Products
55 South Denton Ave.
New Hyde Park, NY 11040

Precision Mechanical Components
Winfred M. Berg Inc.
499 Ocean Avenue
East Rockaway, NY 11518

The following publications are provided to legitimate businesses at little or no cost. You probably cannot buy these items yourself — but most electronic businesses have them and they often show up at hamfests and get sold for a few dollars. The most comprehensive and hence the most valuable is *EEM* which is issued every year. A five or even a ten-year-old set (two volumes) is worth $5.00.

EEM-Electronic Engineers Master Catalog
United Technical Publications

Industrial Products Master Catalog
United Technical Publications

Electronic Industry Telephone Directory
Harris Publishing Company

Electronic Design's Gold Book
Hayden Publishing Co.

With the above publications you should be able to develop an idea of what is generally available and who makes it. Once you have bought something at a hamfest, further research will usually be necessary. After all, what is this thing that you now own? So it's back to the books. Often the complete specifications will be right there in *EEM*. If you must know more about the item, write the manufacturer for a copy of their current catalog.

After the catalog arrives, look it over to see if what you need is there. If it's not, you must be prepared to invest some money in telephone charges. You'd think that if you write a company, you have a right to expect a prompt written reply — right? Wrong. In all probability, you will not get one. Why? Business letters cost money — one estimate is that they average $15.00 each — and this is probably conservative. So if you are writing as an individual, you automatically are classified as a non-customer. Would you blow $15.00? So you probably will not get an answer.

All bets are off if you work for TRW, Bell, or United Technologies, but then, if you do, I should be reading *your* article since you could no doubt teach me a thing or two!

So — you must call! Ask for the sales department. Specify the type of component you are interested in. If a secretary answers, do not automatically assume you need a salesman or an engineer. Tell her exactly who you are, what you have, and the type of information you think you need. Chances are she has the data sheets or knows who has them. Don't be greedy —

all you need is a photocopy of the data stuffed in a hand addressed envelope. If you make it simple, you usually will get at least what you need and, more often than not, a lot more.

How to Hunt

Most hamfests are one day, Sunday, affairs, and end about 3 p.m. If it's held out-of-doors and it rains, they can be considerably shorter. Rain is an ally for you, the buyer, and is the enemy of the seller. I've made some of my best buys in a downpour! By now you probably have come to the conclusion that a hamfest is not a black-tie affair. Dress is purely functional. You should plan to arrive no later than 9 a.m. By that time just about everybody who plans to be there to sell will be set up.

Make one fast trip around all of the tables to develop a mental picture of what is available. With few exceptions, you can spot and exclude the professionals — they have the neat little wooden trays and plastic boxes. Generally these sellers will not have what you want or if they have it, it will cost too much. Look for the person who has it strewn all over the ground or piled in cardboard boxes. In talking to these people I have found that they usually have bought some junque they "really needed" and to get it had to take a lot of junk they don't need. Here is where your junque is to be found. Remember, their "junk" is your "junque."

If you can, find out where it came from and the type of business that used it. It was just this way that I found an absolutely perfect 1P21 photomultiplier tube, in a precision machined aluminum shield, with amplifiers, for $1.00! The seller told me that the goodies came from a pollution control firm that used PMTs to sense changes in air content. When I saw that block of aluminum with black tape over a hole, I knew that I'd hit pay dirt and that the tube inside had not been stressed as are most that are allowed to be exposed to the Sun.

It was also at this "dig" that I had to resist the nemesis of all hamfest aficionados — a deal can be too good. In addition to the PMT which I bought, there were a number of other PMTs that I recognized as such but knew nothing about. The law of diminishing returns holds true for telescope makers. Force yourself to answer the question: Even though this thing was once worth thousands of dollars, can I really use it or will it just collect dust in my basement? I had what I needed, so I left the rest for someone else who needed it and would know how to use it.

Two Sets of Eyes Are Better Than One

It is very helpful to have someone else along. My son, Andrew, came across four Baldwin absolute shaft encoders which I had passed over. Since he is into computers, he had a pretty good idea of what they were. What are they? Well, they will electronically resolve a circle into 2 to the 11th power (2048) parts, which is better than most setting circles I have seen. I totally lost control and bought them for $6 each. Similar new units sell for $800 today. If I had held out a little longer, I might have been able to get them all for $5!

If you find somebody who has the type of parts you are looking for, ask him if he has any more at home. Many times I have found that they left most of the best items at home since your type of junque does not sell well at hamfests. Get his name and address and find out what hamfests he will be attending in the future. Several days before the event call and remind

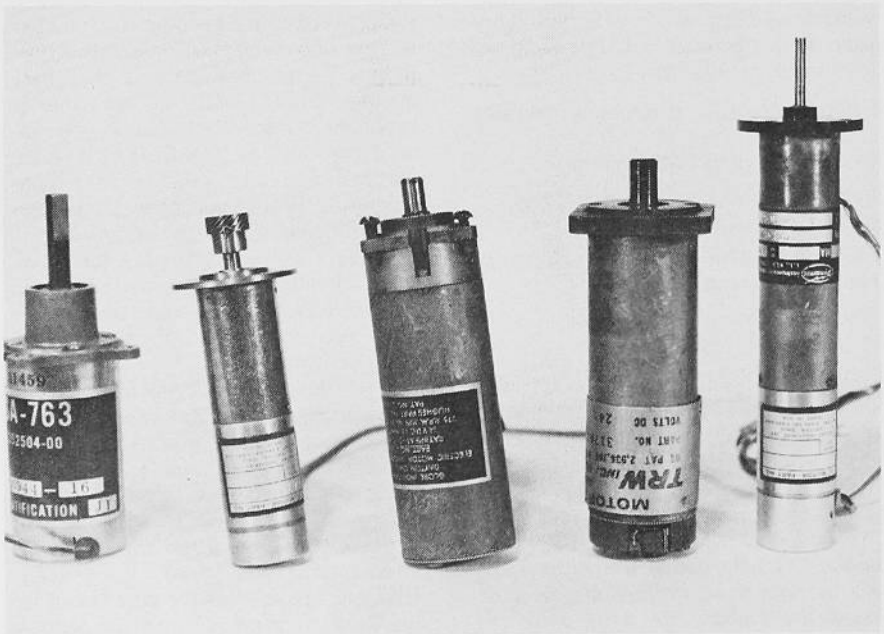
him that you are going to the fest and to bring along the things you are interested in.

Don't Wake a Snake to Kill It

I am sure there must be a dumb ham somewhere — but I have never met him. I have met a lot of ignorant hams, but they do learn quickly, and you don't want to be their teacher. Remember that he sees what you want as having little or no value to him. *Never give him cause to think otherwise.*

If he wants to know what you are going to do with it, tell him it looks interesting and you want to fiddle with it, or strip it down, or use it as a desk ornament. Even if you have written your Ph.D. thesis on the applications of that device, resist the temptation to dazzle. It is amazing how fast a seller can raise his price to meet your desire to pay. Of course, if after you have concluded your business the seller wants to know what you will do with it, go ahead and tell him.

Occasionally you will find war surplus camera lenses and other optical components. I have never seen one that was priced anywhere near what I would pay . . . well . . . save one Metrogon, but the seller had them coming out of his ears. Thousands of aerial camera lenses were made and later surplussed out. Logic says that these lenses ought to be dirt cheap. I doubt that less than one in a thousand of them has ended up doing any kind of useful work in astronomy, or for that matter common photography. In spite of this, however, the asking price



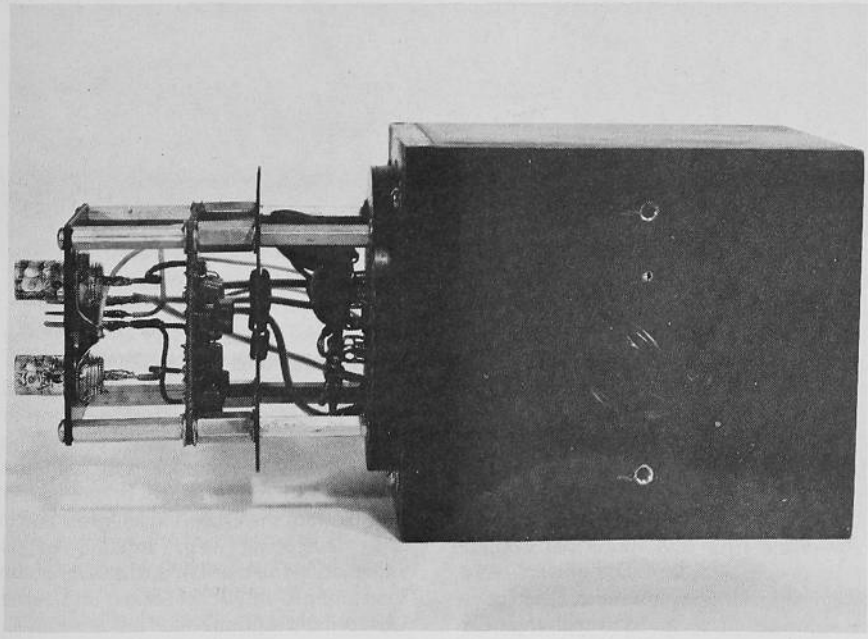
always seems beyond reason. Maybe lenses just plain look valuable no matter what they're really worth. Do not, therefore, go to a hamfest with the object of finding surplus optical bargains.

Hamfests of Note

I have been to most of the hamfests in Virginia, North Carolina, Maryland, Ohio and Michigan. Three are consistently great. They are Dayton (the biggest in the world with 20,000+ attendees); and Findlay, Ohio; and Gaithersburg, Maryland. Unfortunately the latter two were held on the same date in 1981. All is not lost if these are not near you or you can not make it the weekend they are held, since others can be almost as good. In Virginia, there are the Richmond, Manassas, Norfolk, and Winchester gatherings. All of these have contributed to my various telescope making efforts.

Typical ATM Items to Be Found

Here's a partial list of what I have found over the years. An adjustable slit (new from Edmund for several hundred dollars) for $3; metric micrometers used in radar work, linear bearings, hundreds of PIC gears, clutches, bearings, and stainless steel shafting; 4 RPM 95 inch-ounce motors made by Bodine, many Hurst motors, a good assortment of Globe DC motors; DC to 400Hz power converters; ultra-precise 400Hz motors with tachometers; low voltage Slo-Syn stepping motors (did you know you can micro-step one of these down to 3600 steps per revolution?); absolute shaft encoders; photomultiplier tubes; 500 megohm resistors and 1P21 photo-multiplier tubes; 10-turn potentiometers and counter dials to construct an autotracker. Plus more — bearing slides, high intensity arc lamps, and power supplies for a Foucault tester; heavy DC motors, variable voltage transformers and diodes with which to power a grinding and polishing machine. And much, much more . . . .



I am sure that there must be a telescope makers paradise somewhere. It is probably some NASA warehouse stuffed with exotic instrumentation just waiting to be discovered. I doubt that I shall ever see such an accumulation all in one place. However, as I go to hamfests, bits and pieces from this Shangri-La regularly appear and are put to use on my telescopes. Good luck, there is enough for all . . . and then some!

Perry W. Remaklus
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Richmond, VA 23235

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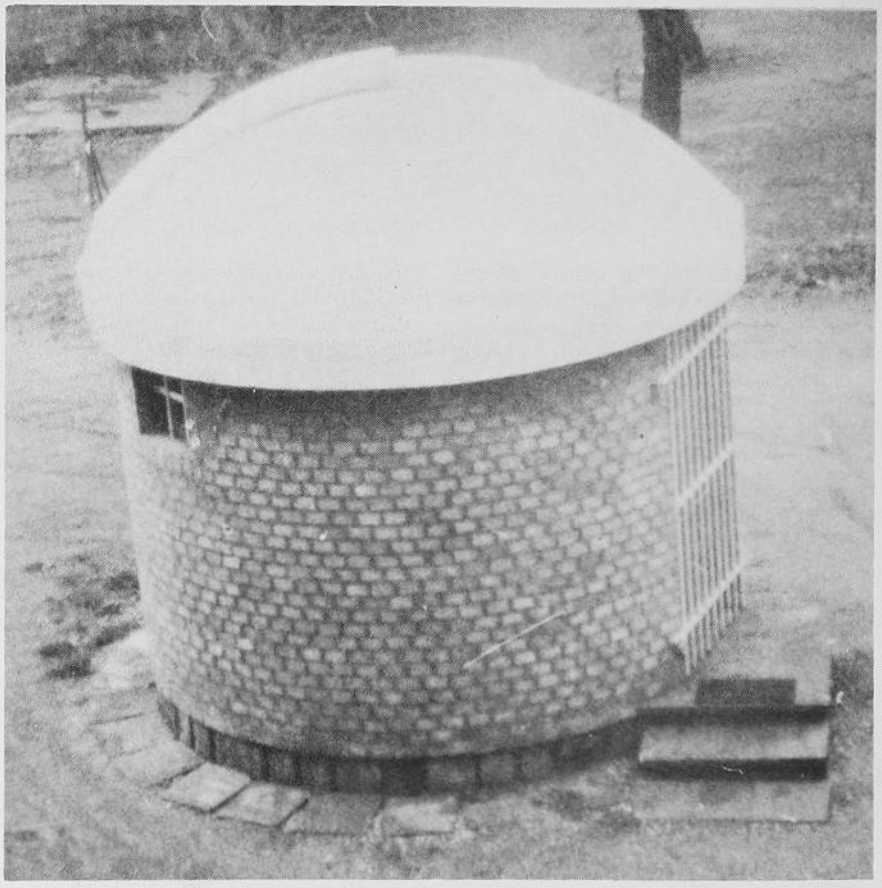
The Georgiana Observatory of Budapest, Hungary

The Georgiana Observatory is the largest private astronomical establishment in Hungary, as well as one of the best-equipped. It was established in 1977, when Harold J. Stelzer of River Forest, Illinois, kindly sent me a 152 mm diameter f/10 Jaegers objective as a generous gift and suggested that I establish an observatory building. The Observatory is located near Budapest, the capital of Hungary, on the bank of the Danube, at 47° 31′ 25″ N latitude and 19° 02′ 33.7″ E longitude. The base of the dome lies 105.38 meters above the mean sea level, and the elevation of the upper observing site is 118.08 meters. The dome has a diameter of 3 meters, and an inside height of some 3.4 meters. The dome, a spherical section, weighs about 600 kg and turns on 12 wheels riding a circular rail. It has a two layer metal wall, made of steel and aluminium alloy with a thick layer of insulating material between the two walls.

The upper observing site is a terrace facing east, across the Danube, over which the air usually is free from dust. Although the center of the metropolis lies at a distance of 3 or 4 kilometers, the light of the city is rather strong and therefore the Observatory does not deal with photometric investigation of variable stars. For the same reason, another observatory near Budapest, the academic Observatory of Hungary, cannot make photometric measurements and therefore a new Observatory has been built in the Matra Mountains, very far from large towns, from which the bulk of variable star and supernova observations are carried out.

Prior to 1977, the largest instruments were a 152 mm diameter f/5 rich-field refractor (with a Jaegers objective) and another refractor having a Jaegers 104 mm diameter f/15 lens, the gift of the Atlanta Astronomy Club. At that time, the Observatory's program was very modest: drawing the distribution of sunspots and searching for lunar transient phenomena. The arrival of the 152 mm ojective created a new situation, and thus the former observing station became an observatory with a broader program.



The Georgiana Observatory on the banks of the Danube.

I received official permission to build the dome from the municipal council without any difficulty. The officers were very helpful and sympathetic. I then gave a commission to an architect-engineer who prepared plans, and after this the building was built.

It was finished in the spring of 1978, and the metal dome was put onto its top in the summer of the same year. The building has a concrete base and the walls are made of hard bricks. After completion, the Observatory grew and is still developing very rapidly, as is reflected in the number and quality of the instruments and accessories, and in the observing program.

The steel skeleton of the dome was constructed in a workshop in a suburb of Budapest, piggybacked to the site atop an automobile, and placed in the brick building.

I am most grateful to Nicholas Herbert, the permanent mechanical expert of the Observatory, whose help is really invaluable. The big telescope, by the way, is dedicated to Mr. Frank Weingartner, a Hungarian-born American, who, together with his wife and children also, has visited the Observatory.

Completed Telescopes

At the time of writing, the Observatory possesses the following completed telescopes. The first figure refers to the clear aperture, while the second is the focal length. Both are given in millimeters.

In the Observatory Building

1. 152/1524 refractor, Jaegers optics;
2. 100/2000 refractor, Hungarian MOM optics;
3. 80/360 transit refractor, MOM optics;
4. 105/400 comet seeker refractor, Czechoslovak optics;
5. 100/1000 Maksutov-Cassegrain astrograph reflector, Soviet optics.

Instruments 1 and 2 are mounted on the same German-type equatorial. Besides a small finder, two 72/500 refractors are used on them as guiding telescopes. Telescope 1 is applied primarily to visual prominence and flare observations, and will be until we complete a new prominence telescope. For these observations, we use it with a Barlow lens system to give a focal length of 4572mm and an H-alpha filter. Instrument 1 is often used for other celestial objects as well, e.g., the Moon, Jupiter, Venus and Saturn or Mars. The second telescope is used exclusively for observation of sunspots. The transit scope, when used, has a place outside the building on the outer wall.

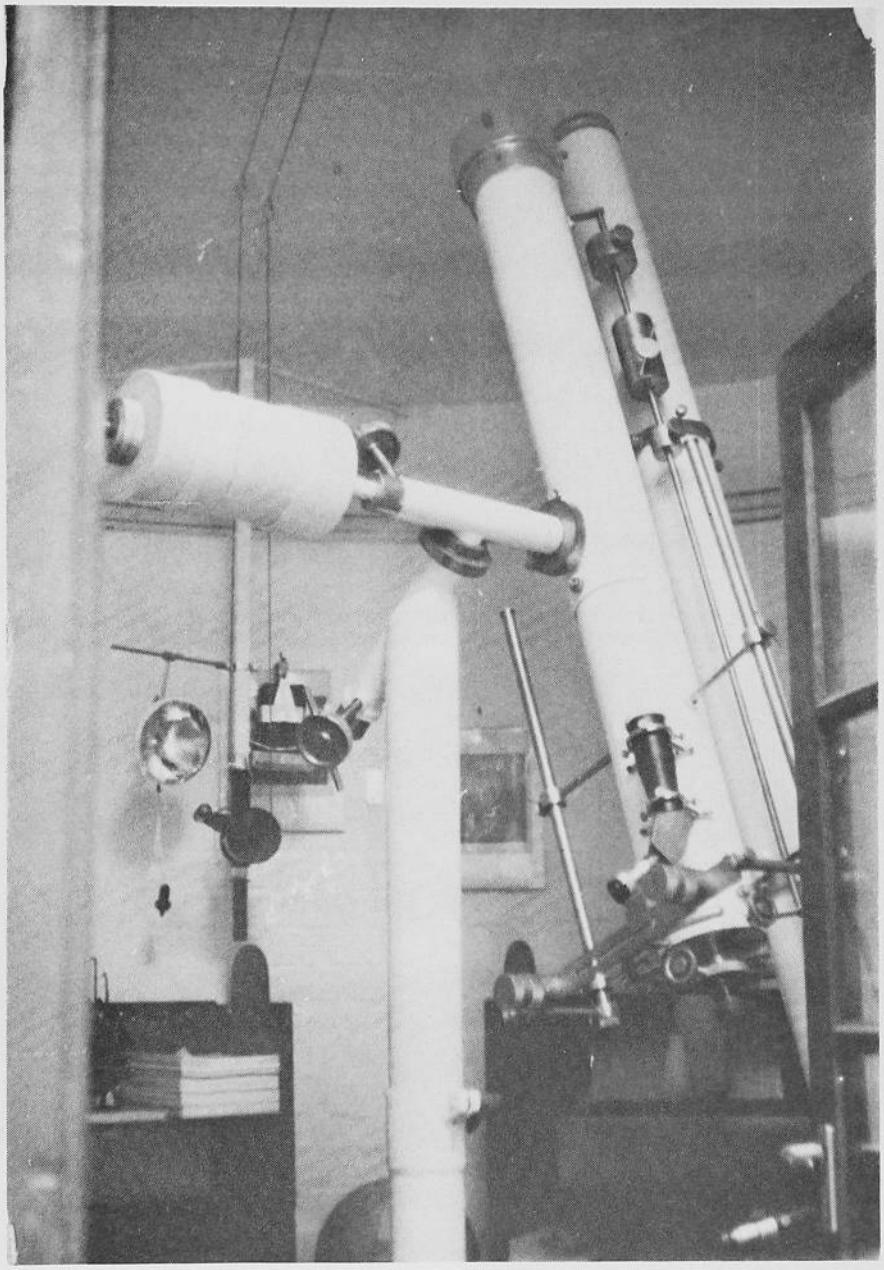
The comet-seeker has a German-type equatorial construction on a wooden tripod. It is an easily portable telescope which we use outside the building. It has a guiding scope, similar to the others, that is a 72/500 refractor. Finally, instrument 5, which was purchased in April 1981, is a short and portable telescope which can be used either on a wooden tripod or on a metal mounting attached to the outer wall of the building. It will be used for solar observations in white light with a Barlow that gives either 2000 or 3000 mm effective focal length.

Upper Observing Site:

6. 60/3400 special folded refractor, used exclusively for the observation of solar flares and prominences at the Sun's limb. The H-alpha filter permits only the observation of limb phenomena and sunspots, while filaments on the disc itself can not be seen by it. This telescope has a German equatorial part which can be put into a metal mounting that is attached to the railing of the terrace; at earlier times it had a wood-tripod. The metal mounting mentioned is a new construction that can be used for other scopes, too. This telescope however, is a little obsolete, so recently instrument 7 has been used for H-alpha work instead of it. It has MOM optics.

7. 152/762 refractor with Jaegers optics. This instrument has its own independent metal German mount. We use it mainly for the projection of the Sun's image and for the micrometric measurements of umbrae and penumbrae of sunspots. In addition, a Barlow system with an effective focal lenth of 4572 mm, it is often used to search for limb prominences and flares.

8. 203/4064 Cassegrain reflector, Coulter optics. It has its own metal German-type mounting. It is used first of



The 152/1524 and 100/2000 refractors in the building (left), and the 104/1575 folded refractor and its finder (right).

all for lunar and planetary studies, and sometimes for solar work as well, usually in conjunction with an interference filter for the observation of the unusual bright rings around sunspots, discovered by Professor Waldmeier of Zurich as early as 1939.

9. 125/400 comet-seeker refractor that can be used as an astrograph as well. It has Zeiss optics. A binocular refractor with MOM objectives, 72/500, is piggybacked on it. This special instrument can be put onto the metal mounting mentioned above, and has a fork mount. It is easily portable and can be placed on a wooden tripod as well.

10. 60/450 refractor, Hungarian optics, on a portable azimuthal tripod, for the fast determination of the altitude of stars above the horizon. This recently obtained nice instrument can be used as a terrestrial telescope as well, since it gives a normal view with a magnification of about 70. This scope can be applied for the calculation of the atmospheric extinction in case of photometric work.

Telescopes under Construction or Planned for Solar Work

11. 104/1575 refractor, Jaegers optics. In a folded form, it will be useful for the observation of limb prominences and flares. The structure of this telescope will follow the scheme shown on page 26 of *Observe and Understand the Sun*, published by the Astronomical League. This scope will be used in the upper observing site and will be put onto the metal mounting mentioned above.

12. 82/1240 refractor, Zeiss optics. I was just informed by Dr. Russell R. Mellon, Research Director of Barnard Observatories, Inc., in Golden, Colorado, that for the sake of the promotion of a cooperation between the Barnard Observatories and the Georgiana Observatory, two big astronomical lenses have been sent to me as free donations. These generous gifts will permit us to construct two telescopes. The 82/1240 objective will be incorporated into a prominence scope similar to #11. We plan that the new telescope will be installed in the dome parallel with the 152/1524 refractor in the place of one of the guiding scopes.

Telescopes Planned for Comet Research

13. 140/700 refractor, Zeiss optics. The objective of this planned refractor is the other lens which is donated by Barnard Observatories. I intend to use this instrument first of all for photographic work on selected areas of the sky. This telescope will be used in both sites. It will be a portable instrument that can be put onto a wooden tripod or the metal mountings mentioned earlier.

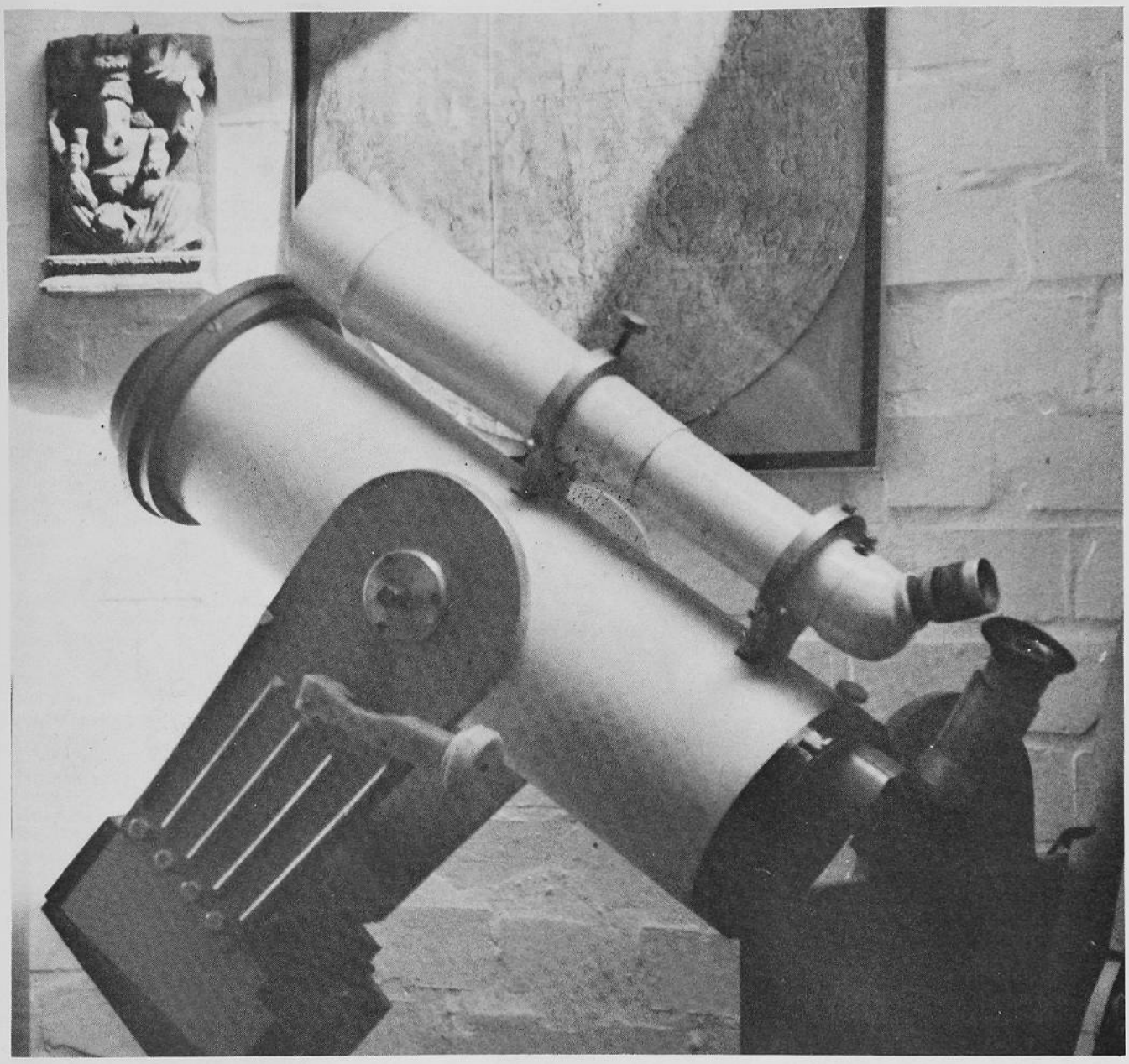
It will receive the 72/500 guide scope to be removed from telescope 1 after the completion of the 82/1240 prominence telescope.

14. 110/500 binocular, Pentacon optics. Two Pentacon-type tele-objectives were purchased recently to make a binocular for deep-sky observations, particularly for seeking comets and asteroids. Both scopes are naturally suitable for photography as well. This binocular, however, will be applied first of all for visual observing outside the dome. A rotating observing chair will be the "mounting" for this fine instrument, similar in structure to the one described in *Sky and Telescope*, February 1981, pp. 162-164.

New Telescopes Planned for General Observation

15. 317/4762 Cassegrain reflector, Coulter optics. At the time of writing, the mirrors are on the way between the United States and Hungary and they will arrive soon. After the completion of this telescope, it will be placed onto the mounting of #8 telescope (the 203/4064 Cassegrain), which will probably be handed over to the Urania Observatory of Budapest. At present I am negotiating with the director of Urania.

16. 317/1905 Newtonian reflector, Coulter optics. The mirror for this has just been ordered. I plan an English-type equatorial mounting for this telescope. It will be installed temporarily in the dome, but since it will be a portable instrument, it will be used outside of the building. It will have a small 80/1250 finder-refractor which can be used as an astrocamera as well.



Major Accessories

Two filar micrometers are at my disposal: one for the measurements of sunspot-diameters, and the other for limb prominences. There are a series of interference filters made by Zeiss, a nebula filter, a polarization filter, solar screens and customary optical filters of different colors, a mechanical and two small electronic calculators, a radio, two photo machines, etc. A Solid State Stellar Photometer, model SSP arrived from OPTEC Inc., in October, 1980.

At present the Observatory possesses a Tuthill-type H-alpha prominence filter and a Schott H-alpha filter. A Calcium-K filter has been ordered recently from Spezial-Glas GMBH, West Germany. Direct solar observations often are made through a filter, having a wavelength of 670 + 4 nm.

The Observatory has a good library with many Hungarian, English, Russian, German, Japanese, and Italian books, periodicals, and star atlases.

It should be mentioned, furthermore, that different photographic lenses are also at my disposal.

The description of the completed and planned instruments and the accessories reflects the situation effective at the end of May 1981.

Scientific Activity

The main program at present is the observation of solar flares and prominences along the limb of the Sun, and the micrometer measurement of the penumbra/umbra ratio of sunspots. In 1980 and 1981, the Observatory has contributed and still contributes to the Solar Maximum Year through the H-alpha prominence and flare observations. The results are reported monthly to the World Data Center A for Solar-Geophysical Phenomena at Boulder, Colorado, and similar reports were sent to the two other World Data Centers in Moscow and Meudon. The results of prominence observations were published in the Solar-Geophysical Data Comprehensive Reports. Our observations are listed with the abbreviation "Geor" meaning "Georgiana" in the column "Mass Ejections from the Sun."

In addition, reports on particularly great prominences (including an eruptive one on March 11, 1979 that reached an altitude of some 234,000 kms) have been published in the *Solar Maximum Year Newsletter*. The Observatory has established a direct contact with the

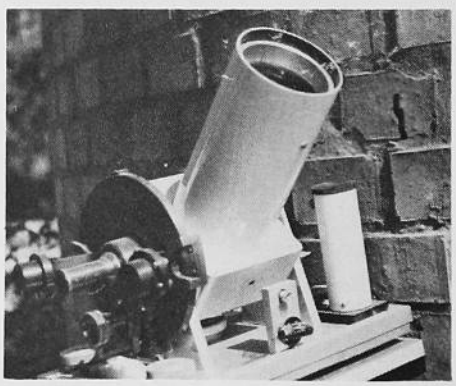
The 152/762 refractor (above) and the 203/4064 Cassegrain (right) at the upper site. Below: the passage instrument beside the building.

Naval Research Laboratory of Washington and has forwarded to them a systematic series on the observed eruptive prominences since February 1979. At NRL, such prominence data are collected and compared with the observational data of coronal transients.

In 1981 the Observatory sent its so-called "Immediate Information on Sunspot and Prominence Observations" to the Naval Research Laboratory, Washington, the World-Date Center A, Boulder, to Professor E. Tandberg-Hanssen of NASA's George C. Marshall Space Flight Center, Alabama, to the Mitaka Observatory, Tokyo, to the Ondrejov Observatory, Ondrejov, Czechoslovakia and to Dr. D. M. Rust, Science Coordinator of Solar Maximum Year, Goddard Space Flight Center, Greenbelt, Maryland, as well as to Mr. H.J. Stelzer, an active participant of AAVSO Solar Division.

The second main program is the search for comets and perhaps asteroids as well. It is now in a very early state. I hope that a very fruitful cooperation with the Barnard Observatories will be achieved. Further work planned is photometry of the Galilean satellites of Jupiter and Titan of Saturn, as well as that of some selected lunar craters. It appears to be an interesting task to make photometric observations of large sunspots to state whether there is any correlation betwen the darkness of umbrae and their diameter. We also plan observations of chromospheric phenomena in the Calcium K line. Finally the observations of the clouds of Jupiter by the new Cassegrain and Newtonian should also be mentioned as a possible future program.

Dr. Peter Hedervari
H. 1023 Budapest, II.
Arpad fejedelem utja
40-41, Hungary



Letters

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The work that was described in the article comes under glass fusing rather than glass casting. Each requires its own kiln characteristics, not mentioned, that influence wire design, placement and most importantly power demands. The use of the graphite cover in the Hill design demands a very large power input, around 5 kilowatts per square foot, which, if extended to 24″ or 30″ mirrors, means lots of amps. If the wires are placed in the walls, as shown in the Fournier book, the power demand comes down for glass that is cast. Although fusing a honeycomb becomes far more difficult, it might not be impossible.

Before getting too enthusiastic, consider the power needed — it's on the order of 240 volts at up to 60 amps for a 24″ blank. A kiln for a 1.8 meter mirror would really require power demands, I think, quite beyond home wire capacity, not to mention cost.

My own idea centered on casting a blank similar to the design proposed for the so-called Nanjing study telescope, outlined in *Applied Optics*, Vol. 19, No. 16, Aug. 1980. The mirror looks like a flattened donut but has a solid structure with half the weight of a normal blank. The mold material that I've used is similar to that used in casting gold or silver. You can get it at jewelry supply houses or mix a combination of silica, sand, cement, and plaster of Paris, as they are able to handle the high temperatures used in slow annealing over several hours.

I've always wondered why more amateurs don't use plate glass for their telescope mirrors. Given its cost vs. the cost of Pyrex, plate glass is ideal. It's cheap, or can be had for the asking; it's easier to melt, although I do realize it's harder to polish and figure. But for those of us in a cash bind, perhaps more credit ought to be given to plate glass. Remember that telescopes have been around a lot longer than Pyrex has.

By the way, my own kiln cost about $500 Canadian to build, versus $2,500 to $3,000 to import a slab of 24″ Pyrex of 4 inches thickness. Even for an individual, the idea of casting one's own is cost-efficient!

Richard Rokosz
23 Lamont Ave.
Scarborough, Ontario
M1S 1A8 Canada

Mini-Observatory

Dear Mr. Berry / One of the many things I enjoy about your magazine is the interest you take in amateur astronomers. I very much enjoy reading and seeing what other stargazers are doing with this great hobby. So, being proud of my own latest achievement in this field, I thought I would drop you a line, and a few photos of my roll-away observatory. My brother-in-law (James Rossman) and myself constructed this building in just two weekends from slab to paint.

The telescope, as you can see, is a C-8. The building for general purposes is five feet square by eight feet tall with a one-inch pitched roof. It weighs approximately 350 pounds and rolls on four 5″ snowmobile wheels. The mount is cemented into the four inch thick slab, and another ten inches cemented with the mount in the ground

below. We built it to roll off to the south, because of poor seeing in that direction. Electric power is via a waterproof cable buried in a trench from the garage at north.

Maybe some of your readers might discover that a small and tight-budgeted building such as this can be very rewarding and makes this hobby just that much more enjoyable.

Charles Baldwin
820 Wildwood Drive
Kokomo, IN 46901

More on Leaking Domes

Sir / In response to John H. Gerrald's letter in TM#14, I have spoken with Ted Wetterman of the Masonite Corporation in Laurel, Mississippi.

Let me first advise that "Masonite®" is a registered trade name — otherwise, we're talking about the generic "hardboards" or "tempered hardboards," as the case may be.

Mr. Wetterman has kindly advised me that until approximately eight years ago, tempered Masonite® was treated with "tempering oil." Since then, however, it has been treated with a phenolformaldehyde resin — the same plastic material found in common electrical light switches. This material is compatible with fiberglassing. Indeed, it is used as a bond in professional fiberglass fabrication.

This professional advice confirms my own experience. I have never had any problem in fiberglassing to Masonite®, tempered or untempered, and especially the more recent tempered variety. Years back I recall a mild oily feel, on occasion, for the former hardboard treated with tempering oil, but for the most part the material either arrived from the yard dried-out, or dried during construction. In the case of the present-day material, the fiberglassing bond is automatic.

My objection to the use of hardboards in dome construction is stress arising from the bending of the material across a compound curve. The problem has to do with the integrity of the hardboard itself under these conditions, whether tempered or not, and with the ability of any nail to hold under outward stress, dome vibration, etc. Most people use plywood ribs, but nailing into the edge of plywood has its own problems!

Finally, Elmers® Professional Carpenter's Wood Glue clearly states on the label: "Resists Heat, Water — also resists lacquer and varnishes," and "Clean-up: Wipe up with clean cloth and warm water." Nowhere does it say waterproof, and nowhere do the manufacturers recommend this product as a waterproof seal.

If you are concerned about the viability of any glue, in or around water, spread some on foil or wax paper, let it dry, and then expose it to water and see what happens! This test can be conducted by anyone, and its results will speak for themselves.

It is my personal opinion that the glue impregnated strips which Mr. Gerrald has applied to his dome joints are themselves being protected by the enamel paint covering them. These glue-treated canvas strips would serve to hold the joints together and contribute to the structure's overall ability to resist vibrations, expansions, contractions, etc., but should the paint ever let water through, there could be significant problems.

These strips would be better applied from the ribs to the sheeting, inside the dome.

My experience is that polyester resin is a good waterproof bonding agent. If applied to the appropriate structural configuration, it is a long-term bonding agent of superior performance.

Jerry R. Warner
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Iowa City, IA 52240

— Mr. Warner also sent a much longer letter on dome materials which we will run as an article in a future issue.

Glass for the Jones-Bird

Dear Mr. Cox / I noticed your "Glass Supply Problem" comment relative to Jones-Bird blanks in TM#8. We provide blanks in our 3″ refractor lens kits made of BK7 and F2 that are suitable for this application but require edging to the required diameter. Our "pre-edging" is to the diameter of our cell, approximately 3.125″. A set of molded blanks for the 3″ aperture objective is $13.50 prepaid.

We can also supply BK-7 blanks suitable for the Houghton Camera. Molded blanks are $49.95 each prepaid. These are intended for a

46►

Blue Pages

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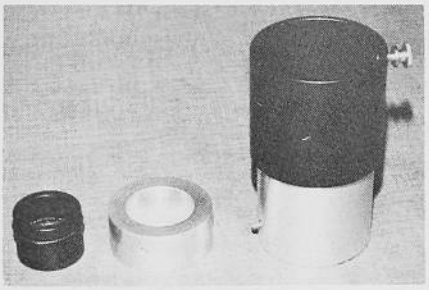
Norman A. Remer
N. Remer Optics
1230 Mill Creek Circle
Southampton, PA 18966

Barlow Adaptor

Sirs / I enjoy using a 2" diameter 32mm eyepiece and thought it would be nice to be able to use this fine eyepiece with a Barlow to take advantage of its good quality and long eye relief. As I had a 2" Novak extension tube, a friend made me a simple aluminum bushing that slide-fits into the end of the tube and accepts the innards of a Goodwin Barlow. The lens is mounted in the front end of the Novak tube to give me maximum amplification. The Barlow and bushing are held in place with setscrews and do not extend beyond the end of the extension tube, so it will stand on end without rolling off a table.



I use this Barlow with more than one telescope, and it works out so well that I seldom use other eyepieces now. The eye relief is a big bonus, and the power is easily increased by pulling the 2" eyepiece out an inch and refocusing the rack and pinion, effectively giving me a variable power Barlow.

Jon A. Nehls
13837 Laramie
Crestwood, IL 60445

Dobsonian Wrinkles

Dear Richard / Please note that I have enclosed your forms, "duly signed and executed." Frankly, I could not care less about this. I am not a writer and have no intention of reprinting or sending my suggestions elsewhere. As far as I am concerned, they are for you to do with as you see fit, my small way of saying "thank you" to you people for making available to me the marvels of a big-aperture low-cost telescope. Any way I can make this instrument more enjoyable to others who cannot afford the fancy expensive rigs is reward enough.

Anyhow, here's another very simple add-on: I tacked a ¼" x 2" slat on the rear edge of the top surface of the tube box. This acts as a lip to hold charts, books, etc., and it works well.

And another: to stop the tube from sliding down in the the box especially at high elevation, I merely made two wire hooks using heavy duty coathanger wire, two small turnbuckles, and two screws. Make an eye-loop with pliers and fasten it inside the tube box with large round head wood screws. The wire should be attached to turnbuckle eyes in their fully extended position with the tube just barely rear of the balance point. I found two of these at opposite corners worked best.

Please consider the above my gift to you-all. I disclaim, disavow, will not reprint, or re-anything them, etc. They are yours to do with as you see fit.

Wally Pursell
12635 Parnell Ave.
Baton Rouge, LA 70815

— Thank you, Wally. Our lawyer says we need the forms. TM policy is to grant permission to any author to reprint an article on request — all you must do is let us know.

Small Parts Sources

Dear Richard / Re: My letter in TM #11, page 32, about minimum orders and sources of small screws.

I got two direct responses shortly after TM #11 came out. One was from Dave Chrestenson, who sent you a summarized version of his letters to me. The other respondent, a Ben Hawkins of Littleton, CO, sent me a card from Small Parts, Inc. and said that he had found their catalog a "real gold mine." I sent for one — believe me, he was right. Every ATM, TM, or TN ought to have a copy. Small Parts aims at being a "Source and

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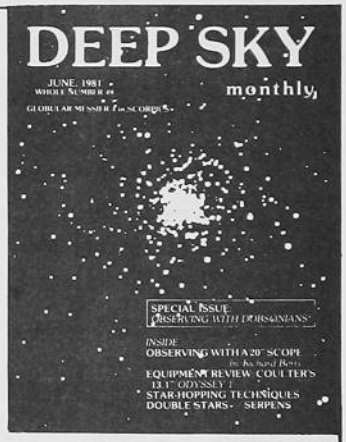

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Letters

Service" to R&D scientists — and if they knew about us they could easily expand their line to include crazy ATMs. Why don't you send for one of their catalogs and see what you think of it?

We ATMs badly need a more complete directory of supplies, parts, gadgets, components, etc. than the Blue Pages of TM is furnishing us. I don't know the answer, but I do know that Edmund Scientific isn't it.

Any directory which lists drives and doesn't include Byers, Mathis, and Kenneth Wolf isn't giving the whole story. I don't know the answer, but I sure wish we had some kind of compendium of this kind of information.

And, by the way, I still don't know where I can buy 1.25" I.D. tubing by the foot. That minimum quantity situation is a real problem.

Earle Dodds
703 Courtland Avenue
Muscle Shoals, AL 35660

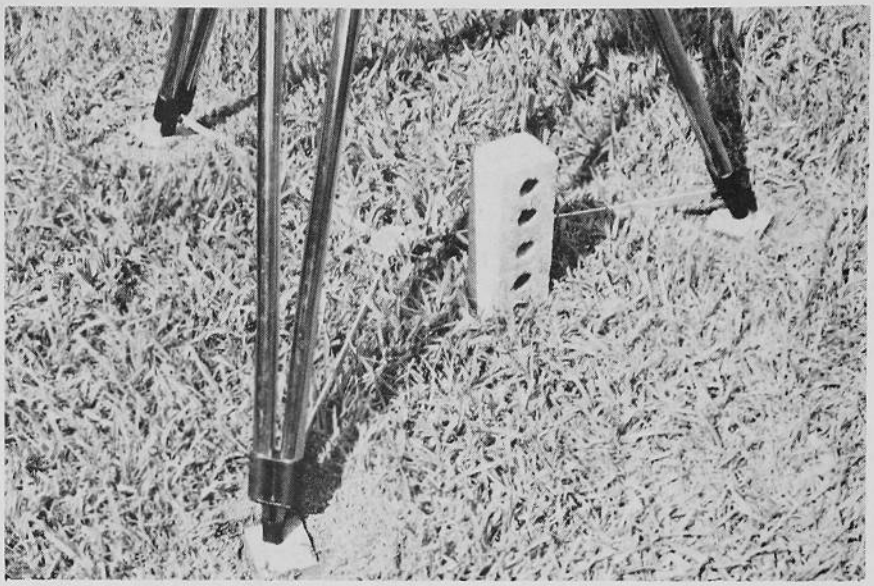
— I ordered the Small Parts catalog and after it came, promptly sent off for $33 dollars worth of good stuff. Unfortunately, I added it up wrong and sent them a check for $32, but they sent me the order anyway with a nice note asking for the extra dollar. Good service too — just five days.

TM's directory listing hasn't worked out the way I hoped it would. It's dirt-cheap to be listed, and TM readers are a prime audience, but it's never caught on in a big way. Our space ads are doing better, and I'm pleased to see small companies that can't afford an ad in ASTRONOMY or S&T are taking out space in TM.

For that matter, I had to drop "What's New" as a regular feature of TM because I wasn't getting enough material for it. "What's New" was genuine honest-to-goodness freebie ad space, and nobody seemed to want it. Hear me suppliers: send enough announcements of your new products and we'll revive "What's New."

Supporting a Tripod

Dear Mr. Berry / Polaris is frequently covered by clouds even when it is clear overhead at my house. I believe it's due to the fact that I live just south of Lake Pontchartrain which is 24 miles wide and about 40 miles long. The differential heating between the land and such a large body of water seems to favor cloud formation along the shore.



Anyhow, setting up my tripod-mounted telescope used to prove tedious when Polaris was hidden. The situation arose often enough that I simply had to do something about it. I wasn't ready to put a permanent pier in the middle of my backyard, so I cast about for a quick fix. That's when I thought of bricks.

One night I aligned my telescope with exceptional care, and then drove pencils into the ground next to each foot of the tripod. The next day, I dug in bricks, standing them on end and flush with the ground. It took an unexpected amount of effort to get the east-west bricks level, but the north brick lined up easily. The result was pleasing — and the price was right.

Using my telescope is now a snap. I simply set the feet on the bricks and plug in the drive. Practice has taught me how to position it just right. It tracks almost perfectly for visual observation, and I've even done limited piggyback photography without further alignment.

The bricks have not moved measurably in the nearly two years that they have been in use, so my "temporary" design is beginning to appear permanent. I suspect that the three brick trick would not work in cold climates where the ground is subject to frost heaves.

William C. Bell
3517 Clearview Pkway
Metairie, LA 70002

Cutting Sontube

Note 4 Richard Berry / Black and Decker sells a knife blade for sabre saws which cuts Sonotube and other cardboard tube very well. People building Dobsonians might find this useful.

Rick Schaffer
Altadena, CA

More Glass Woes . . .

Dear Richard / I read with great interest the letters "Glass at Last" and "More Glass," then contacted Cincinnati Gasket Packing and Mfg. Inc. as suggested by Richard Wessling. Their response was less than heartwarming — they suggested I contact Corning Glass

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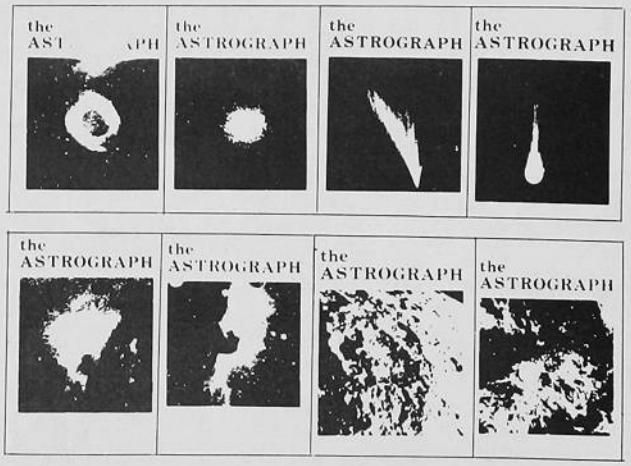

Letters

Works, Corning, NY 14880, Attn.: Optical Dept., as their 1.25" sheet pyrex is commercial grade and not suitable for telescope mirrors. Too bad.

What about starting a list of people willing to purchase large glass blanks from Corning in order to encourage them to make a few in the 2.12" or thicker range? I'll be first on the list. If enough people did this we might get some blanks. In the Albany Astronomy Group we have at least 3 people wanting large blanks. Keep up the good work.

Mark Urbaetis
Rt. 2 Box 250
Rexford, NY 12148

17.5" Dobsonian

Dear TELESCOPE MAKING Magazine / Enclosed are pictures of my recently completed Dobsonian made with the Coulter 17.5" mirror. Construction is conventional except for the tube which was constructed with ¾" plywood braced internally with triangle reinforcements to ensure rigidity. Since the scope is permanently housed in my yard, weight is no problem.

The spider vanes were constructed with metal shelf brackets epoxied onto a grooved plywood block. The eyepiece holder is the only conventional item purchased. Note the large handles which facilitate turning the scope. The declination bearings are old phonograph turntables.

The scope moves smoothly without vibration or backlash and stays put in any position. A sharp rap yields vibrations which damp out in 2-3 seconds.

Credit is due to recent articles in TM and ASTRONOMY for help with the construction. Presently I am working my way through the Messier list and plan to start on NGC objects soon.

I have never built a reflector before, but the brilliance of Mr. Dobson's design is now readily apparent with the smooth controls and perfect collimation of a telescope built without precision materials. This design is a throwback to the early days of amateur telescope making, but it probably represents the best value in aperture and ease of use in any visual telescope.

H. Lazerson
8540 S. Sepulveda Blvd.
Suite 1115
Los Angeles, CA

P.S. I keep the optics in the scope and covered with a lamb's wool pack when not in use. The scope is covered with large waterproof tarpaulins as suggested by W.E. Pennell in the *1976 Yearbook of Astronomy* by Patrick Moore — if it works in England, it should be okay in California!

Ray Tracing Booklet

Dear Mr. Berry / I read with interest the article in TM #14 regarding the design of Maksutov telescopes by Bill Sutherland. The article made frequent references to *Optical Design and Ray-Tracing by Pocket Calculator*. For the benefit of your readers, I would like to correct the address on page 39 of the article as a source for the book. It is now available from Willmann-Bell Inc., P.O. Box 3125, Richmond, VA 23235. In their latest catalog it is listed at $7.50 plus $1.00 handling. The book is also available from Optica b/c Company, 4100 MacArthur Blvd, Oakland, CA 94619 and from the publisher at the address below.

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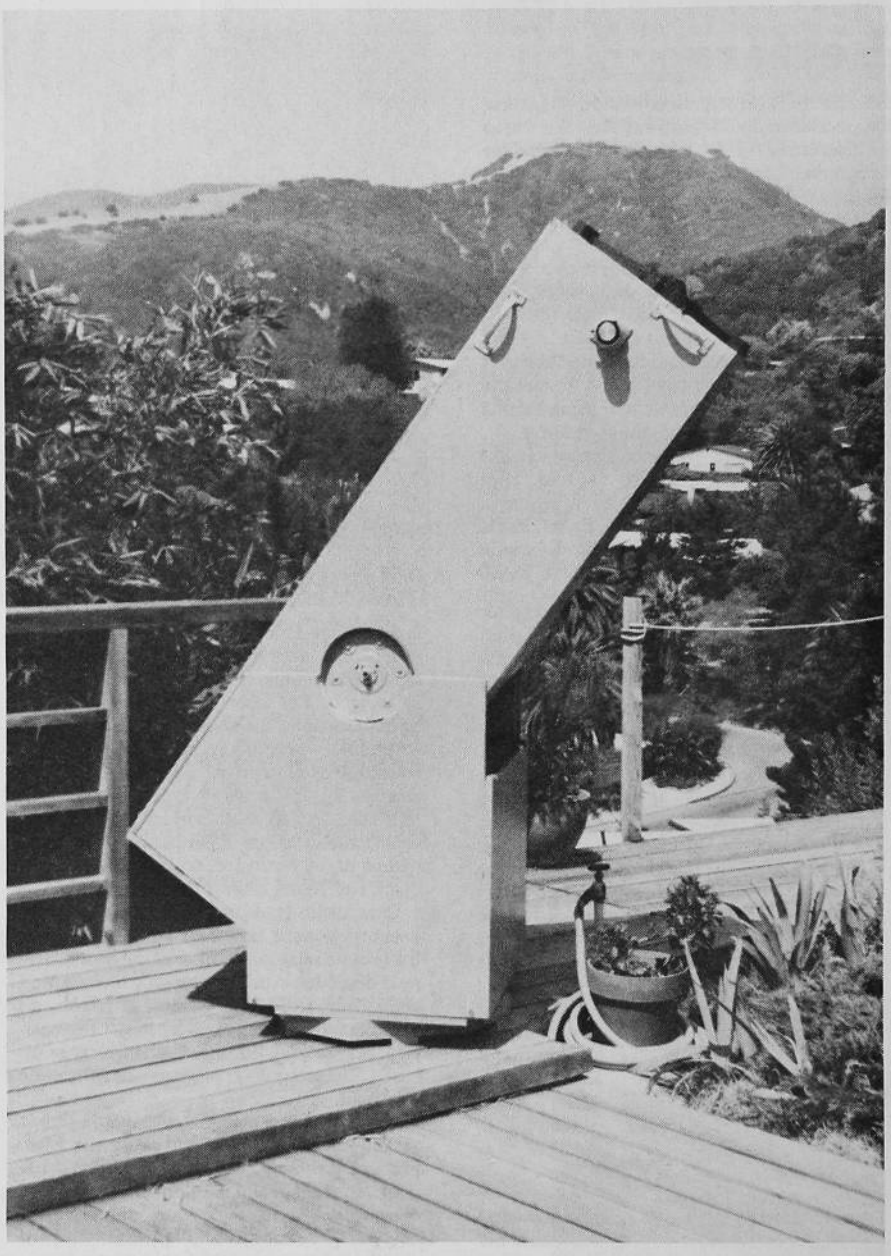
Innovative Optical Materiel
P.O. Box 243
Crest Park, CA 92326



Not a Supply Sider

Dear Sir / When reading through TM#14, I found the pages devoted to "Commercial Telescopes: the View from the Supply Side" a waste of valuable space and an insult to the intelligence of your readers. Buying a telescope is not any different from buying a camera, a car, or a suit.

There is no "art of telescope making" in those pages, and in the event you were short of articles, it would have been better to publish TM with fewer pages and make up for it in the next issues.

Please do not misunderstand me. I appreciate TM, but not the long-winded article from Celestron.

A.L.Ponjee
200D High Point Dr. #2-205
Hartsdale, NY 10530

— Thanks for your candid letter. I feel that the article was justified in TM. Questions that I have received from readers and the general astronomical community, not to mention the disastrous experiences of Charles Turner (see TM#13 Letters) and lots of others, have convinced me that many people don't have any notion of how telescopes and telescope parts are marketed and sold. If publishing that article helped just one person make a better decision, or saves one person getting burned, then it served its purpose. Like it or not, TMs (and TM editors) are the people expected to know the answers.